CHAPTER 2

GENERAL MAINTENANCE EQUIPMENT

As an ABF, you are routinely assigned tasks requiring the use of hand or power tools. It is to your advantage to become familiar with the tools you will use to accomplish these tasks. The right tool for the right job is an old, but time proven, proverb.

SAFETY is paramount when you are using tools— power or hand operated. Special care should be used with all wood or metal cutting tools. Eye goggles must be in place before cutting tools are used.

Power tools are more dangerous than nonpowered tools. Use power tools only if you are familiar with them and have been checked out on their use and proper operation by a competent authority.

Tools and Their Uses, NAVEDTRA 10085-B2, contains more detailed information on the various tools the ABF will use.

COMMON HAND TOOLS

LEARNING OBJECTIVES: Identify the common hand tools used by the ABF. Explain the use and care of hand tools.

Figure 2-1 illustrates some of the hand tools discussed in this section. All hand tools have a specific

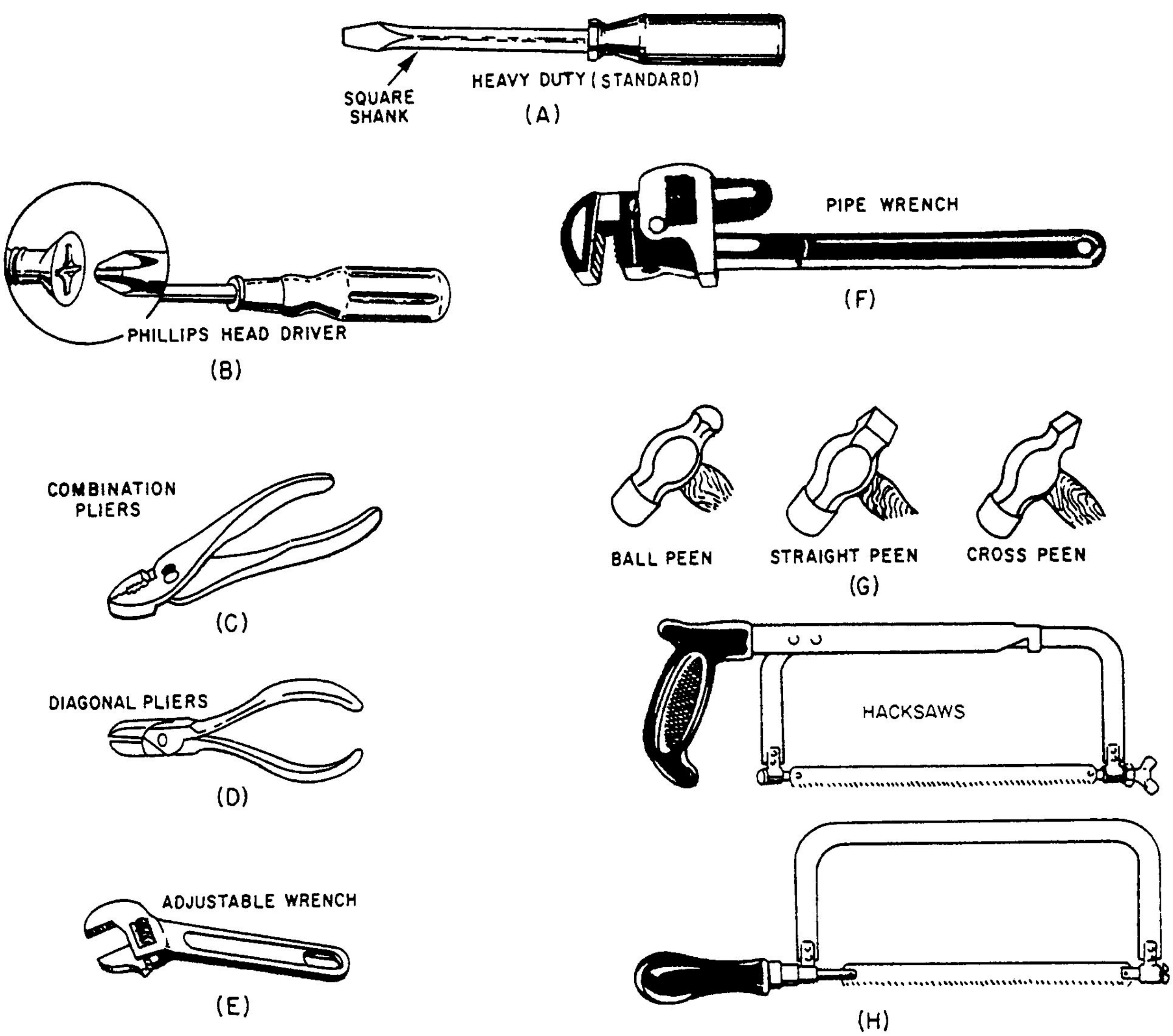


Figure 2-1.—Common hand tools.

purpose and should be used only on the objects they are designed for. When you use a hand tool for other purposes, you usually damage both the tool and the object it is used on. Use screwdrivers to drive and remove screws. Do not use them to scrape paint, as a pry bar or chisel, and certainly never use them to test an electrical circuit.

STANDARD SCREW DRIVER

Three main parts make up the construction of the standard screwdriver (fig. 2-1, view A), the handle, the shank, and the end. The end (called the blade) fits into the screw slot. When using a screwdriver, select the proper size blade for the job intended. A blade too large or too small causes the screwdriver blade and the screwhead to become damaged. At least 75 percent of the screw slot should be filled by the blade for proper fit.

PHILLIPS HEAD SCREWDRIVER

A Phillips head screwdriver (fig. 2-1, view B) differs in construction from a standard screwdriver only in that the tip is shaped to fit the special cavity in the Phillips screwhead. A standard screwdriver must never be used in a Phillips screwhead as damage will occur to it. The Phillips cavity should be filled completely by the selected driver for proper fit.

HAMMER

The hammer (fig. 2-1. view G) most used by the ABF is the ball peen. The ball peen hammer is used for working metals, such as chiseling rivets and shearing metal.

COMBINATION PLIERS

Combination pliers (fig. 2-1, view C) are manufactured with straight serrated jaws for gripping objects. The pivots, with which the jaws are attached, are adjustable to fit different size objects. Pliers should not be used to grasp the shanks of screwdrivers to gain greater twisting force.

DIAGONAL PLIERS

Diagonal pliers (fig. 2-1, view D) are used only for cutting small material such as wire or cotter pins. They are designed specifically for cutting. They should NOT be used for grasping objects such as nuts and bolts.

ADJUSTABLE WRENCHES

An adjustable wrench (fig. 2-1, view E) is not intended to replace an open-end wrench, but it is useful in working in restricted areas. In addition, it can be adjusted to fit odd-sized nuts or bolts. This wrench is often called a knuckle buster because mechanics frequently suffer the consequences of using it improperly.

PIPE WRENCHES

A pipe wrench (fig. 2-1, view F) is primarily used for rotating round stock and/or various pipes and piping. The most common pipe wrench is the Stillson. It has two jaws that have serrated teeth to provide a gripping ability. The larger jaw is a fixed jaw. The smaller jaw is adjustable and the weaker of the two jaws. Whenever a Stillson wrench is used, it should be applied in such a manner that the fixed jaw provides the twisting force. These wrenches also come in varying lengths, which makes the jaw sizes vary. A Stillson wrench should never be used on machined surfaces, as the teeth tend to mar or otherwise ruin the metal.

The strap wrench (fig. 2-2) should be used instead of a Stillson to eliminate damage to soft metals. The strap wrench employs a heavy nylon strap. One end is attached to the wrench handle. while the other end is free to pass around the object to be rotated, and then back through the locking device provided on the wrench handle.

SPANNER WRENCHES

Many special nuts are made with notches cut into their outer edge. For these nuts a hook spanner

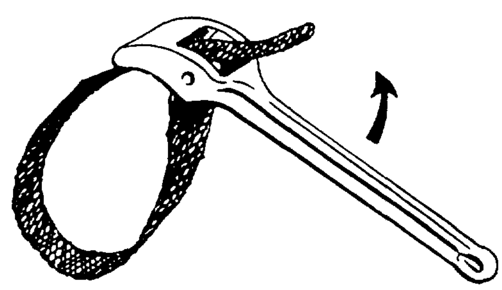


Figure 2-2.—Strap wrench.

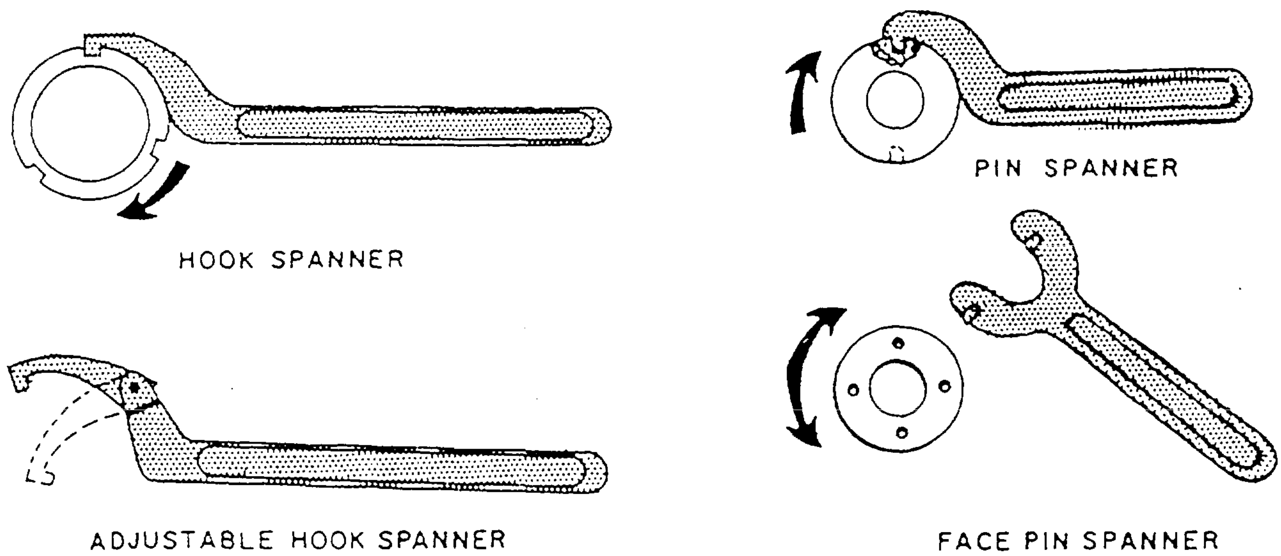


Figure 2-3.—General purpose spanner wrenches.

(fig. 2-3) is required. This wrench has a curved arm with a lug or hook on the end. This lug fits into one of the notches of the nut and the handle is turned to loosen or tighten the nut. This spanner may be made for just one particular size of notched nut, or it may have a hinged arm to adjust it to a range of sizes.

Another type of spanner is the pin spanner. Pin spanners have a pin in place of a hook. This pin fits into a hole in the outer part of the nut.

Face pin spanners are designed so the pins fit into holes in the face of the nut (fig. 2-3).

When you use a spanner wrench, you must ensure the pins, lugs, or hooks make firm contact with the nut while the turning force is applied. If this is not done, damage will result to either personnel, tools, or equipment.

SETSCREW WRENCHES (ALLEN AND BRISTOL)

In some places it is desirable to use recessed heads on setscrews and capscrews. The Allen screw is used extensively on office machines and in machine shops. The Bristol is used infrequently.

Recessed head screws usually have a hexshaped (six-sided) recess. To remove or tighten this type of screw requires a special wrench that will fit in the recess. This wrench is called an Allen wrench. Allen wrenches are made from hexagonal L-shaped bars of tool steel (fig. 2-4). They range in size up to 3/4 inch. When using the Allen wrench, make sure you use the correct size to prevent rounding or spreading the head of the screw. A snug fit within the recessed head of the screw is an indication that you have the correct size.

The Bristol wrench is made from round stock. It is also L-shaped, but one end is fluted to fit the flutes or little splines in the Bristol setscrew (fig. 2-4).

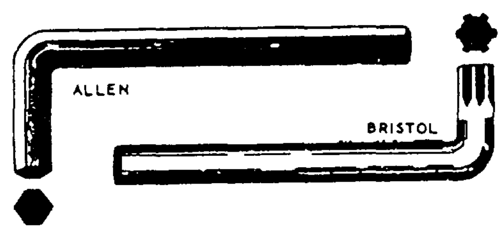


Figure 2-4.—Allen and Bristol wrenches.

SOCKET WRENCH

The socket wrench is one of the most versatile wrenches in the toolbox. It consists of a handle and a socket wrench that can be attached to the handle.

The Spintite wrench shown in figure 2-5, is a special type of socket wrench. It has a hollow shaft to accommodate a bolt protruding through a nut, has a hexagonal head, and is used like a screwdriver. It is supplied in small sizes only and is useful for assembly and electrical work. When used for the latter purpose, it must have an insulated handle.

A complete socket wrench set consists of several types of handles, bar extensions, adapters, and a variety of sockets (fig. 2-5).

Sockets

A socket (fig. 2-6) has a square opening cut in one end to fit a square drive lug on a detachable handle. In the other end of the socket is a 6-point or 12-point opening very much like the opening in the box end wrench. The 12-point socket needs to be swung only half as far as the 6-point socket before it has to be lifted and fitted on the nut for a new grip. It can therefore be used in closer quarters where there is less room to move the handle. (A ratchet handle eliminates the necessity of lifting the socket and refitting it on the nut every time a turn is made.)

Sockets are classified for size according to two factors. One is the size of the square opening, which fits on the square drive lug of the handle. This size is known as the drive size. The other is the size of the opening in the opposite end, which fits the nut or bolt. The standard toolbox can be outfitted with sockets having 1/4-, 3/8-, and 1/2-inch square drive lugs. Larger sets are usually available in the toolroom for temporary checkout. The openings that fit onto the bolt or nut are usually graduated in 1/16-inch sizes. Sockets are also made in deep lengths to fit over spark plugs and long bolt ends.

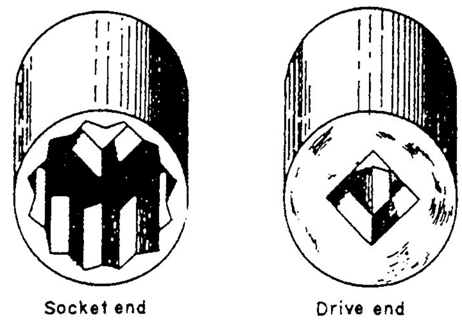


Figure 2-6.—12-point socket.

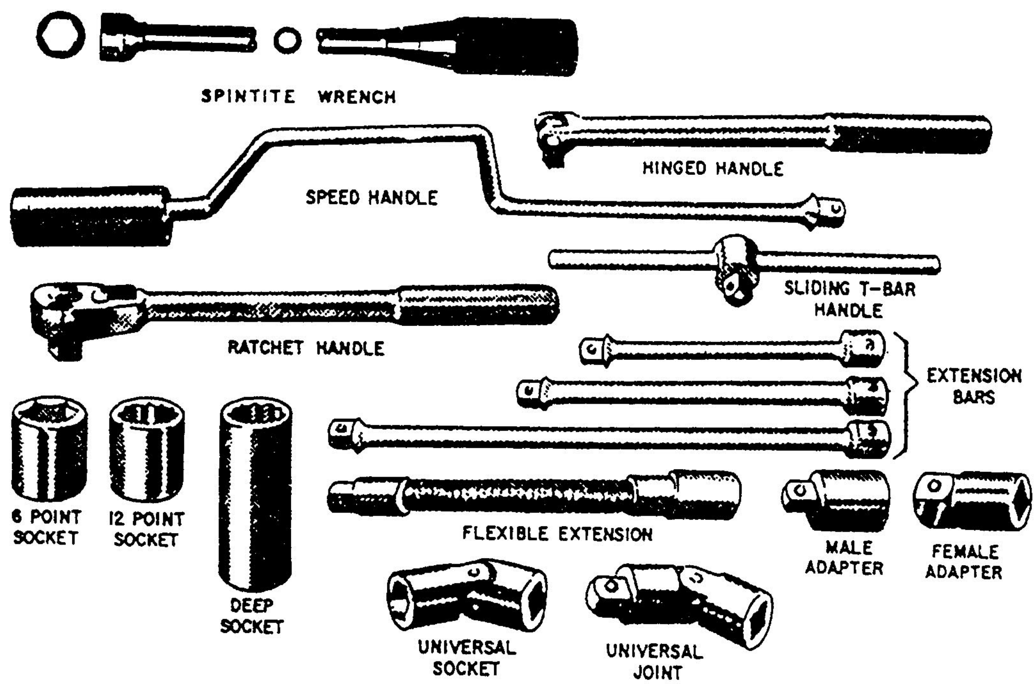


Figure 2-5.—Socket set components.

Socket Handles

There are four types of handles used with these sockets. (See fig. 2-5) Each type has special advantages, and the experienced worker chooses the one suited for the job at hand. The square driving lug on the socket wrench handles has a spring-loaded ball that fits into a recess in the socket receptacle. This mated ball-recess feature keeps the socket engaged with the drive lug during normal usage. A slight pull on the socket, however, disassembles the connection.

RATCHET.— The ratchet handle has a reversing lever that operates a pawl (or dog) inside the head of the tool. Pulling the handle in one direction causes the pawl to engage in the ratchet teeth and turn the socket. Moving the handle in the opposite direction causes the pawl to slide over the teeth, permitting the handle to back up without moving the socket. This allows rapid turning of the nut or bolt after each partial turn of the handle. With the reversing lever in one position, the handle is used for tightening. In the other position, it is used for loosening.

HINGED HANDLE.— The hinged handle is also very convenient. To loosen tight nuts, swing the handle at right angles to the socket. This gives the greatest possible leverage. After loosening the nut to the point where it turns easily, move the handle into the vertical position, and then turn the handle with the fingers.

SLIDING T-BAR HANDLE.— When using the sliding bar or T-handle, the head can be positioned anywhere along the sliding bar. Select the position that is needed for the job at hand.

SPEED HANDLE.— The speed handle is worked like the wood-worker's brace. After the nuts are first loosened with the sliding bar handle or the ratchet handle, the speed handle can be used to remove the nuts more quickly. In many instances the speed handle is not strong enough to be used for breaking loose or tightening the nut. The speed socket wrench should be used carefully to avoid damaging the nut threads.

Accessories

To complete the socket wrench set, there are several accessory items. Extension bars of different lengths are made to extend the distance from the socket to the handle. A universal joint allows the nut to be turned with the wrench handle at an angle. Universal sockets are also available. The use of universal joints, bar extensions, and universal sockets in combination with appropriate handles makes it possible to form a variety of tools that will reach otherwise inaccessible nuts and bolts.

Another accessory item is an adapter that allows you to use a handle having one size of drive and a socket having a different size drive. For example, a 3/8- by 1/4-inch adapter makes it possible to turn all 1/4-inch square drive sockets with any 3/8-inch square drive handle.

HACKSAW

The hacksaw is a handy portable metal cutting tool that can be used for cutting sheet metal, bolts, and pipe. A hacksaw cuts on the push stroke only; the blade should be installed in the frame with the teeth facing away from the handle. Figure 2-1, view H, shows two types of hacksaws with the blade in the proper position.

CHISELS

Chisels are tools that can be used for chipping or cutting metal. They will cut any metal that is softer than the materials of which they are made. Chisels are made from a good grade tool steel and have a hardened cutting edge and beveled head. Cold chisels are classified according to the shape of their points, and the width of the cutting edge denotes their size. The most common shapes of chisels are flat (cold chisel), cape, round nose, and diamond point (fig. 2-7).

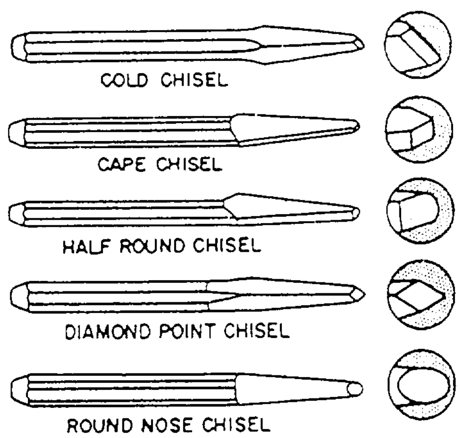


Figure 2-7.—Types of points on metal cutting chisels.

The type of chisel most commonly used is the flat cold chisel, which serves to cut rivets, split nuts, chip castings, and thin metal sheets. The cape chisel is used for special jobs like cutting keyways, narrow grooves, and square corners. Round-nose chisels make circular grooves and chip inside corners with a fillet. Finally, the diamond-point is used for cutting V-grooves and sharp comers.

As with other tools there is a correct technique for using a chisel. Select a chisel that is large enough for the job. Be sure to use a hammer that matches the chisel; that is, the larger the chisel, the heavier the hammer. A heavy chisel will absorb the blows of a light hammer and will do virtually no cutting.

As a general rule, hold the chisel in the left hand with the thumb and first finger about 1-inch from the top. It should be held steadily but not tightly. The finger muscles should be relaxed, so if the hammer strikes the hand it will permit the hand to slide down the tool and lessen the effect of the blow. Keep the eyes on the cutting edge of the chisel, not on the head, and swing the hammer in the same plane as the body of the chisel. If you have a lot of chiseling to do, slide a piece of rubber hose over the chisel. This will lessen the shock to your hand.

When using a chisel for chipping, always wear goggles to protect your eyes. If other personnel are working close by, ensure they are protected from flying chips by erecting a screen or shield to contain the chips. Remember that the time to take these precautions is before you start the job.

FILES

A toolkit for nearly every rating in the Navy is not complete unless it contains an assortment of files. There are several different types of files in common use, and each type may range in length from 3 to 18 inches.

Grades

Files are graded according to the degree of fineness and according to whether they have single or double-cut teeth. The difference is apparent when you compare the files in figure 2-8, view A.

Single-cut files have rows of teeth cut parallel to each other. These teeth are set at an angle of about 65 degrees with the center line. You will use single-cut files for sharpening tools, finish filing, and drawfiling. They also are the best tools for smoothing the edges of sheet metal.

Files with crisscrossed rows of teeth are double-cut files. The double cut forms teeth that are diamond-shaped and fast cutting. You will use double-cut files for quick removal of metal and for rough work.

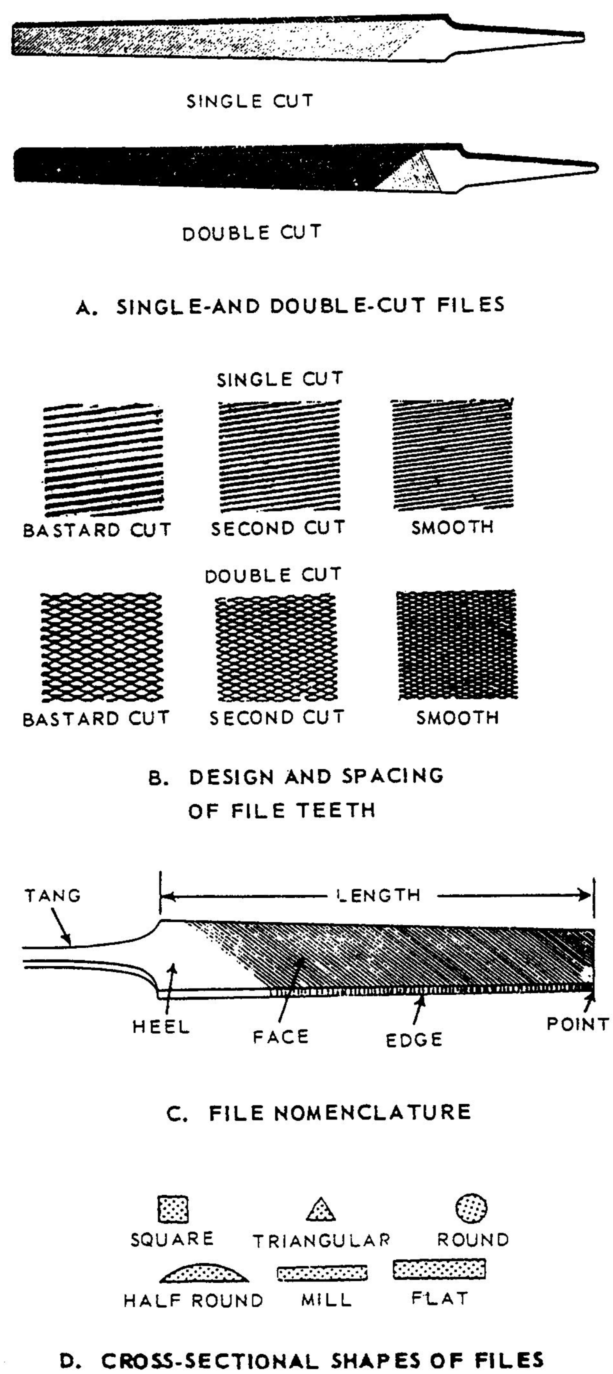


Figure 2-8.—File descriptions.

Files are also graded according to the spacing and size of their teeth, or their coarseness and fineness. Some of these grades are pictured in figure 2-8, view B. In addition to the three grades shown, you may use some DEAD SMOOTH files, which have very fine teeth, and some ROUGH files with very coarse teeth. The fineness or coarseness of file teeth is also influenced by the length of the file. The length of a file is the distance from the tip to the heel, and does not include the tang (fig. 2-8, view C). When you have a chance, compare the actual size of the teeth of a 6-inch, single-cut smooth file and a 12-inch, single-cut smooth file. You will notice the 6-inch file has more teeth per inch than the 12-inch file.

Shapes

Files come in different shapes. Therefore, in selecting a file for a job, the shape of the finished work must be considered. Some of the cross-sectional shapes are shown in figure 2-8, view D.

TRIANGULAR files are tapered (longitudinally) on all three sides. They are used to file acute internal angles and to clear out square comers. Special triangular files are used to file saw teeth.

MILL files are tapered in both width and thickness. One edge has no teeth and is known as a SAFE EDGE. Mill files are used for smoothing lathe work, drawfiling, and other fine, precision work. Mill files are always single-cut.

FLAT files are general-purpose files and may be either single- or double-cut. They are tapered in width and thickness. HARD files, not shown, are somewhat thicker than flat files. They taper slightly in thickness, but their edges are parallel.

The flat or hard files most often used are the double-cut for rough work and the single-cut, smooth file for finish work.

SQUARE files are tapered on all four sides and are used to enlarge rectangular-shaped holes and slots. ROUND files serve the same purpose for round openings. Small, round files are often called “rattail” files.

The HALF ROUND file is a general-purpose tool. The rounded side is used for curved surfaces and the flat face on flat surfaces. When you file an inside curve use a round or half round file whose curve most nearly matches the curve of the work.

Kits of small files, often called Swiss pattern or jewelers files, are used to fit parts of delicate mechanisms and for filing work on instruments. Handle these small files carefully because they break easily.

TAPS AND DIES

Taps and dies are used to cut threads in metal, plastics, or hard rubber. The taps are used for cutting internal threads, and the dies are used to cut external threads. There are many different types of taps. However, the most common are the taper, plug, bottoming, and pipe taps (fig. 2-9).

The taper (starting) hand tap has a chamfer length of 8 to 10 threads. These taps are used when starting a tapping operation and when tapping through boles.

Plug hand taps have a chamfer length of 3 to 5 threads and are designed for use after the taper tap.

Bottoming hand taps are used for threading the bottom of a blind hole. They have a very short chamfer length of only 1 to 1 1/2 threads for this purpose. This tap is always used after the plug tap has already

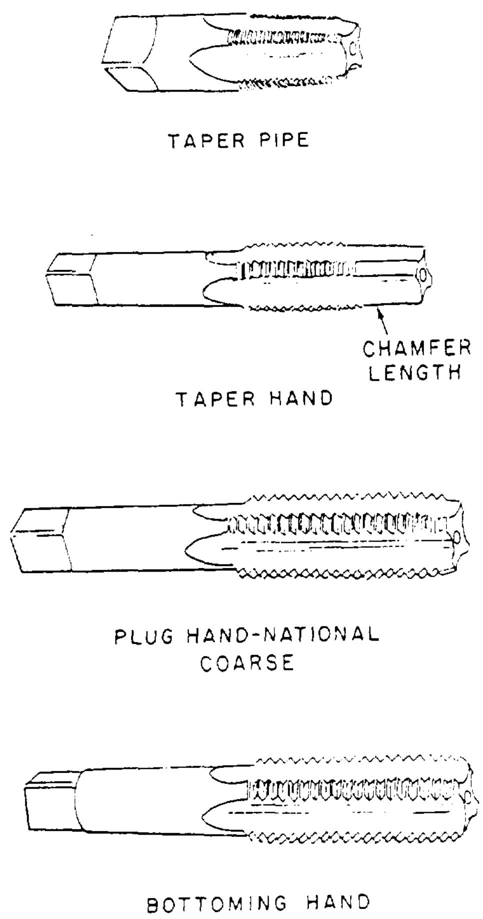


Figure 2-9.—Types of common taps.

been used. Both the taper and plug taps should precede the use of the bottoming hand tap.

Pipe taps are used for pipe fittings and other places where extremely tight fits are necessary. The tap diameter, from end to end of the threaded portion, increases at the rate of 3/4 inch per foot. All the threads on this tap do the cutting, as compared to the straight taps where only the nonchamfered portion does the cutting.

Dies are made in several different shapes and are of the solid or adjustable type. The square pipe die (fig. 2-10) will cut American Standard pipe thread only. It comes in a variety of sizes for cutting threads on pipe with diameters of 1/8 inch to 2 inches.

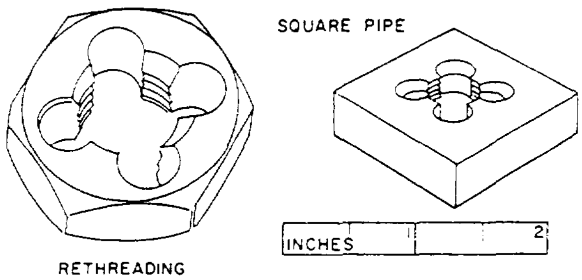


Figure 2-10.—Types of solid dies.

A rethreading die (fig. 2-10) is used principally for dressing over bruised or rusty threads on screws or bolts. It is available in a variety of sizes for rethreading American Standard coarse and fine threads. These dies are usually hexagon in shape and can be turned with a socket, box, open-end, or any wrench that will fit. Rethreading dies are available in sets of 6, 10, 14, and 28 assorted sizes in a case.

Round split adjustable dies (fig. 2-11) are called button dies and can be used in either hand diestocks or machine holders. The adjustment in the screw adjusting type is made by a fine-pitch screw that forces the sides of the die apart or allows them to spring together. The adjustment in the open adjusting types is made by three screws in the holder, one for expanding and two for compressing the dies. Round split adjustable dies are available in a variety of sizes to cut American Standard coarse and fine threads, special form threads, and the standard sizes of threads that are used in Britain and other European countries. For hand threading, these dies are held in diestocks (fig. 2-12). One type of diestock has three pointed screws that will hold round dies of any construction,

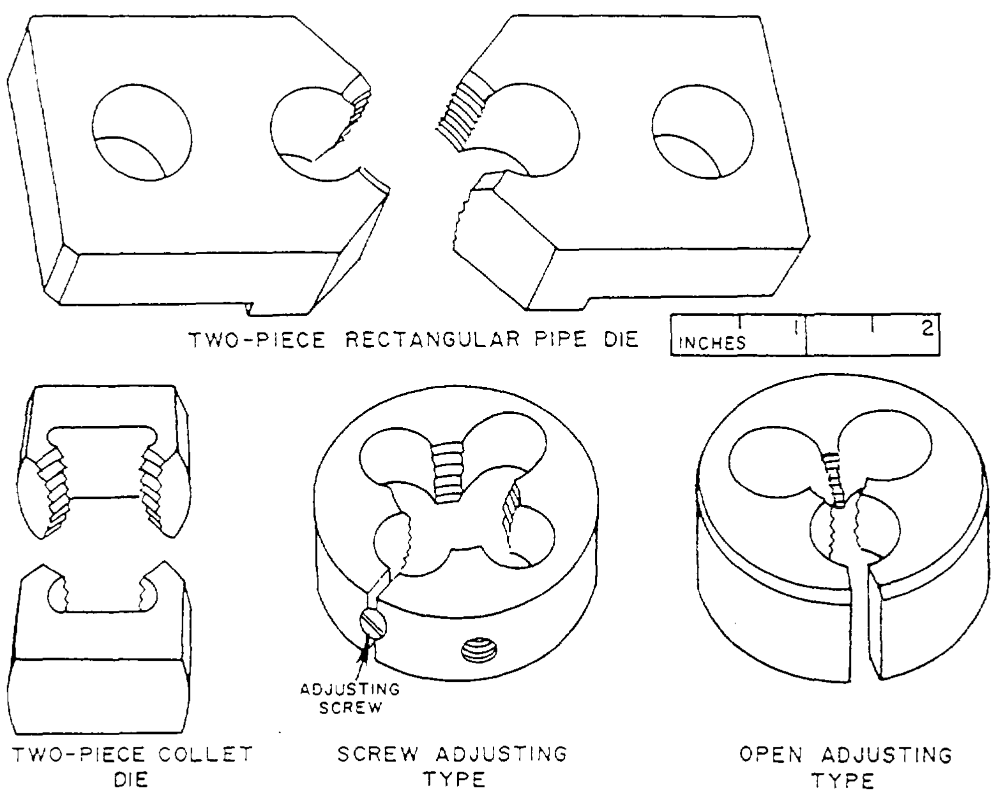


Figure 2-11.—Types of adjustable

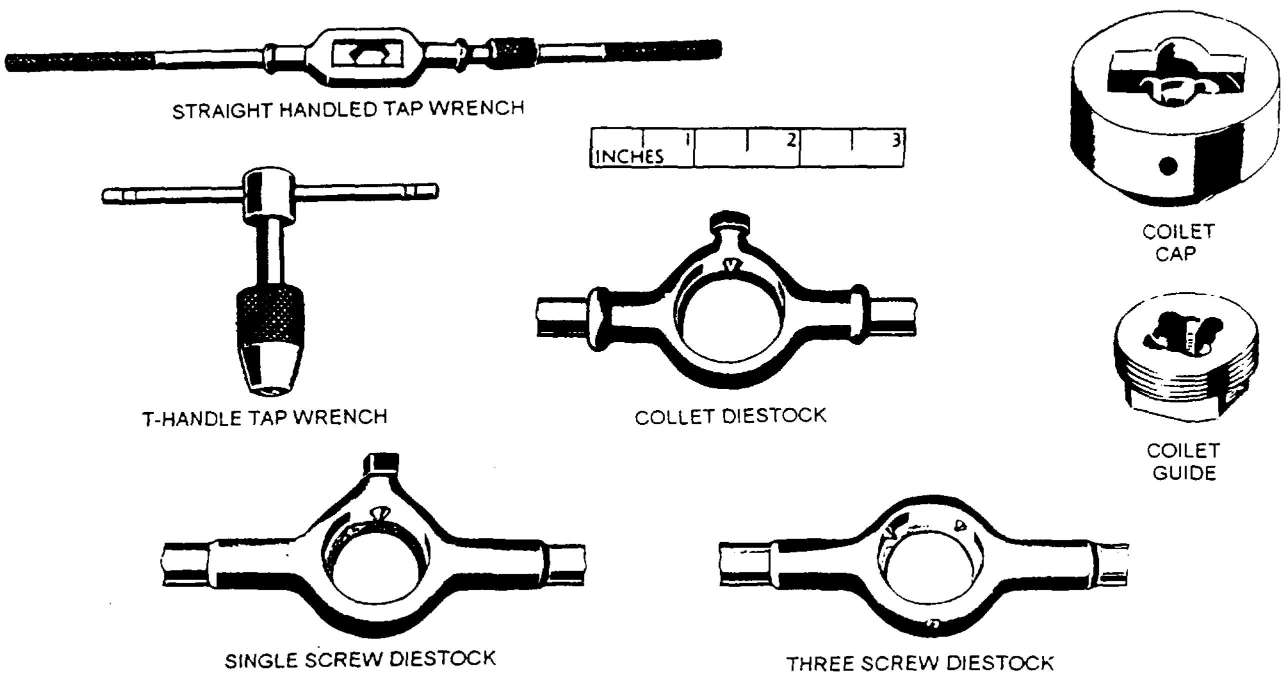


Figure 2-12.—Diestocks, diecollet, and tap wrenches.

although it is made specifically for open adjusting-type dies.

Two-piece collet dies (fig. 2-11) are used with a collet cap (fig. 2- 12) and a collet guide. The die halves are placed in the cap slot and are held in place by the guide that screws into the underside of the cap. The die is adjusted by setscrews at both ends of the internal slot. This type of adjustable die is issued in various sizes to cover the cutting range of American Standard coarse and fine and special form threads. Diestocks to hold the dies come in three different sizes.

Two-piece rectangular pipe dies (fig. 2-11) are available to cut American Standard pipe threads. They are held in ordinary or ratchet-type diestocks (fig. 2-13). The jaws of the dies are adjusted by set-screws. An adjustable guide serves to keep the pipe in alinement with respect to the dies. The smooth jaws of the guide are adjusted by a cam plate. A thumbscrew locks the jaws firmly in the desired position.

Threading sets are available in many different combinations of taps and dies, together with diestocks, tap wrenches, guides, and necessary screwdrivers and wrenches to loosen and tighten adjusting screws and

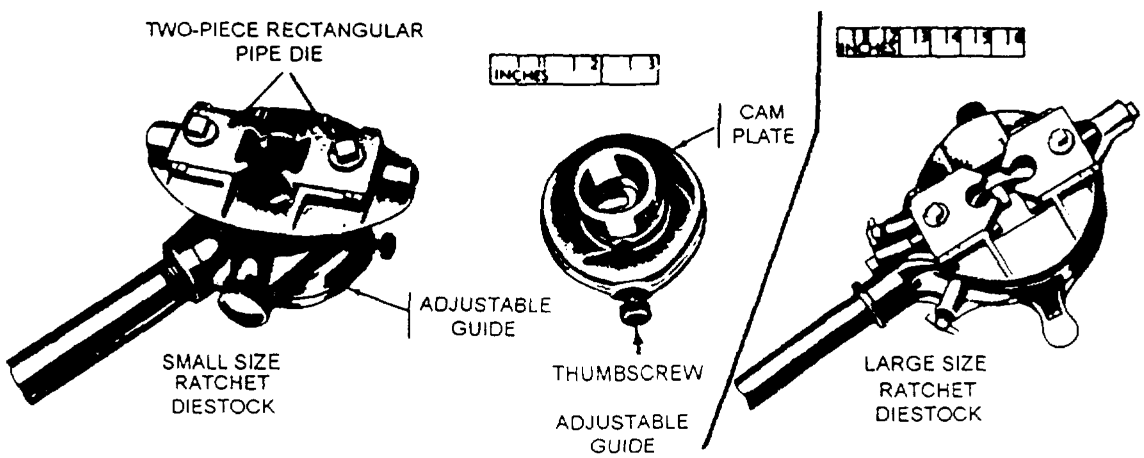


Figure 2-13.—Adjustable die guide and ratchet diestocks.

bolts. Figure 2-14 illustrates a typical threading set for pipe, bolts, and screws.

Never attempt to sharpen taps or dies. Sharpening of taps and dies involves several highly precise cutting processes that involve the thread characteristics and chamfer. These sharpening procedures must be done by experienced personnel to maintain the accuracy and the cutting effectiveness of taps and dies.

Keep taps and dies clean and well oiled when not in use. Store them so they do not contact each other or other tools. For long periods of storage, coat taps and dies with a rust-preventive compound, place in individual or standard threading set boxes, and store in a dry place.

SCREW AND TAP EXTRACTORS

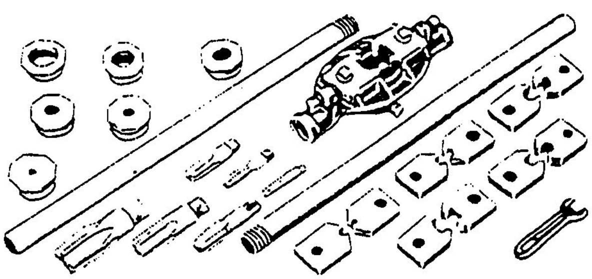
Screw extractors are used to remove broken screws without damaging the surrounding material or the threaded hole. Tap extractors are used to remove broken taps.

Some tap extractors (fig. 2-15, view A) are straight, having flutes from end to end. These extractors are available in sizes to remove broken screws having 1/4- to 1/2-inch outside diameters (O.D.). Spiral tapered extractors (fig. 2-15, view B) are sized to remove screws and bolts from 3/16-inch to 2 1/8-inches O. D..

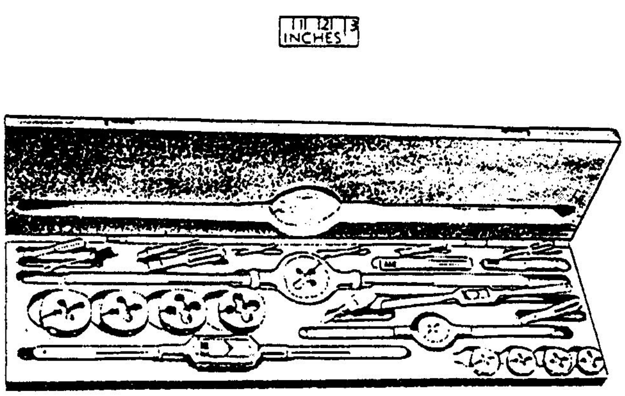
Most sets of extractors include twist drills and a drill guide. Tap extractors are similar to the screw extractors and are sized to remove taps ranging from 3/16- to 2 1/8-inches O. D..

To remove a broken screw or tap with a spiral extractor, first drill a hole of proper size in the screw or tap. The size hole required for each screw extractor is stamped on it. The extractor is then inserted in the hole and turned counterclockwise to remove the defective component.

If the tap has broken off at the surface of the work, or slightly below the surface of the work, the straight tap extractor shown in figure 2-15, view A, may re-move it. Apply a liberal amount of penetrating oil to the broken tap. Place the tap extractor over the broken tap and lower the upper collar to insert the four sliding

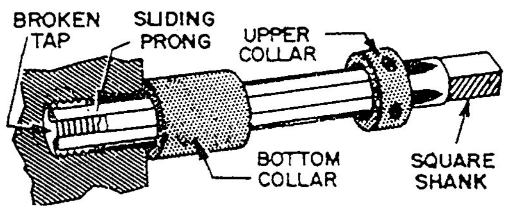


PIPE THREADING SET WITH RECTANGULAR ADJUSTABLE DIES, DIESTOCK, WRENCH, GUIDES AND TAPS

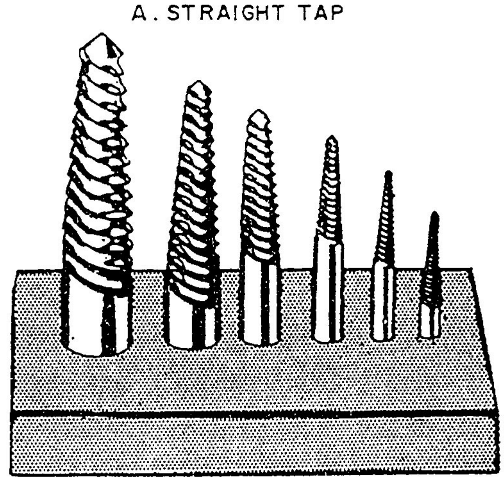


BOLT AND SCREW THREADING SET WITH ROUND ADJUSTABLE SPLIT DIES, DIESTOCKS, TAPS, TAP WRENCHES, AND SCREWDRIVERS

Figure 2-14.—Threading sets.



A. STRAIGHT TAP



B. SPIRAL SCREW

Figure 2-15.—Screw and tap extractors.

prongs down into the four flutes of the tap. Then slide the bottom collar down to the surface of the work so it will hold the prongs tightly against the body of the extractor. Tighten the tap wrench on the square shank of the extractor and carefully work the extractor back and forth to loosen the tap. It may be necessary to remove the extractor and strike a few sharp blows with a small hammer and pin punch to jar the tap loose. Then reinsert the tap remover and carefully try to back the tap out of the hole.

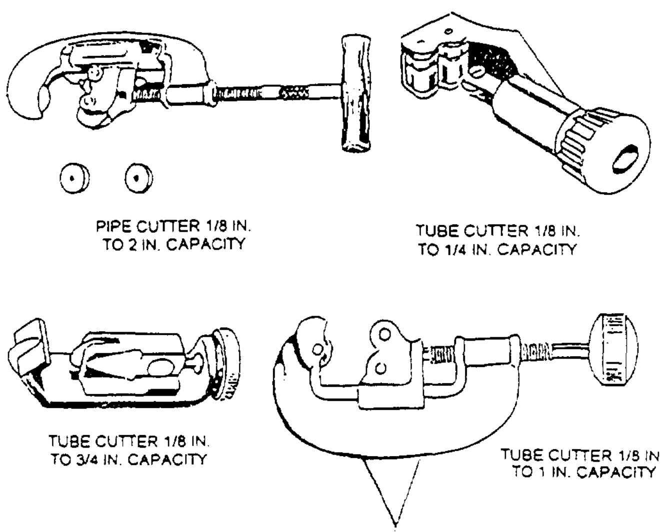


Figure 2-16.—Pipe and tubing cutters.

PIPE AND TUBING CUTTERS AND FLARING TOOLS

Pipe cutters (fig. 2-16) are used to cut pipe made of steel, brass, copper, wrought iron, and lead. Tube cutters (fig. 2-16) are used to cut tubing made of iron, steel, brass, copper, and aluminum. The essential difference between pipe and tubing is that tubing has considerably thinner walls. Flaring tools (fig. 2-17) are used to make single or double flares in the ends of tubing.

Two sizes of hand pipe cutters are generally used in the Navy. The No. 1 pipe cutter has a cutting capacity of 1/8 to 2 inches, and the No. 2 pipe cutter has a cutting capacity of 2 to 4 inches. The pipe cutter has a special alloy-steel cutting wheel and two pressure rollers that are adjusted and tightened by turning the handle.

Most tube cutters closely resemble pipe cutters, except they are of lighter construction. A hand screw feed tubing cutter of 1/8-inch to 1 1/4-inch capacity has two rollers with cutouts located off center so that cracked flares may be held in them and cut off without waste of tubing. It also has a retractable cutter blade that is adjusted by turning a knob. The other tube cutter shown is designed to cut tubing up to and including 3/4- and 1-inch O.D. Rotation of the triangular portion of the tube cutter within the tubing will eliminate any burrs.

Flaring tools are used to flare soft copper, brass, or aluminum. The single flaring tool consists of a split

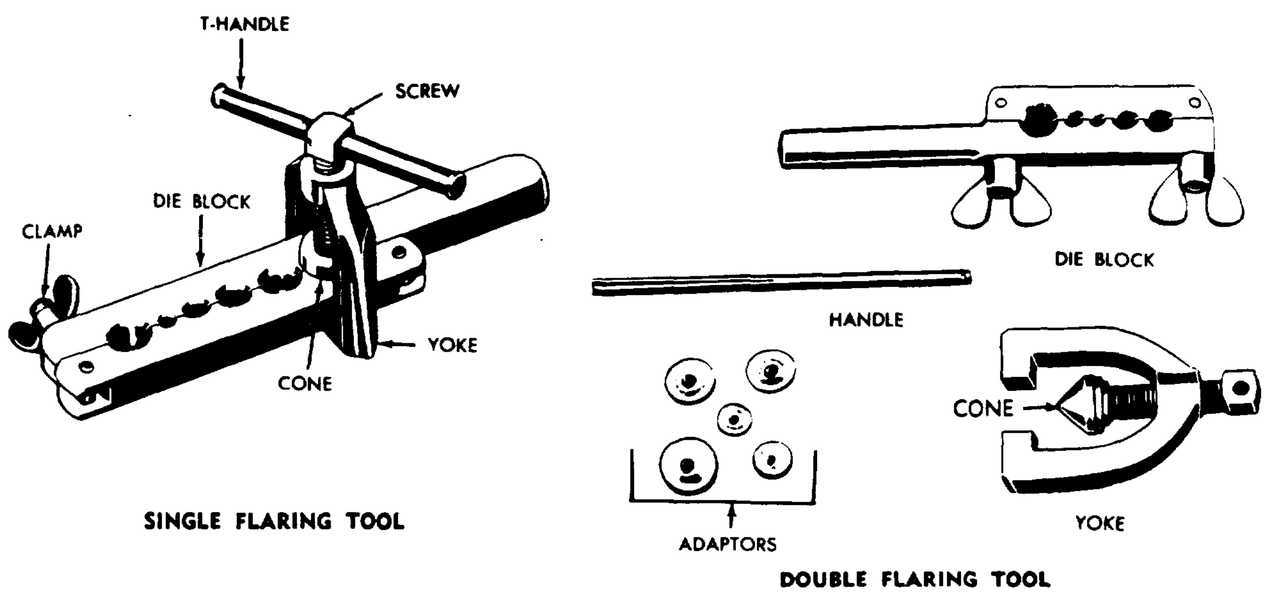


Figure 2-17.—Flaring tools.

die block that has holes for 3/16-, 1/4-, 5/16-, 3/8-, 7/16-, and 1/2-inch O.D. tubing, and a clamp to lock the tube in the die block. It also has a yoke that slips over the die block and has a compressor screw and a cone that forms a 45-degree flare or a bell shape on the end of the tube. The screw has a T-handle. A double flaring tool has the additional feature of adapters that turn in the edge of the tube before a regular 45-degree double flare is made. It consists of a die block with holes for 3/16-, 1/4-, 5/16-, 3/8-, and 1/2-inch tubing, a yoke with a screw and a flaring cone, plus five adapters for different size tubing, all carried in a metal case.

CARE OF HAND TOOLS

Tools are expensive, vital equipment. When the need for their use arises, common sense plus a little preventive maintenance prolongs their usefulness. The following precautions for the care of tools should be observed:

1. Clean tools after each use. Oily, dirty, and greasy tools are slippery and dangerous.

2. NEVER hammer with a wrench.

3. NEVER leave tools scattered about. When not in use, stow them neatly on racks or in toolboxes.

4. Apply a light film of oil after cleaning to prevent rust on tools.

5. Inventory tools after use to prevent loss.

TACKLE

A tackle is an assembly of blocks and ropes used to gain a mechanical advantage in lifting or pulling. Figure 2-18 shows the name and location of various main parts of a tackle.

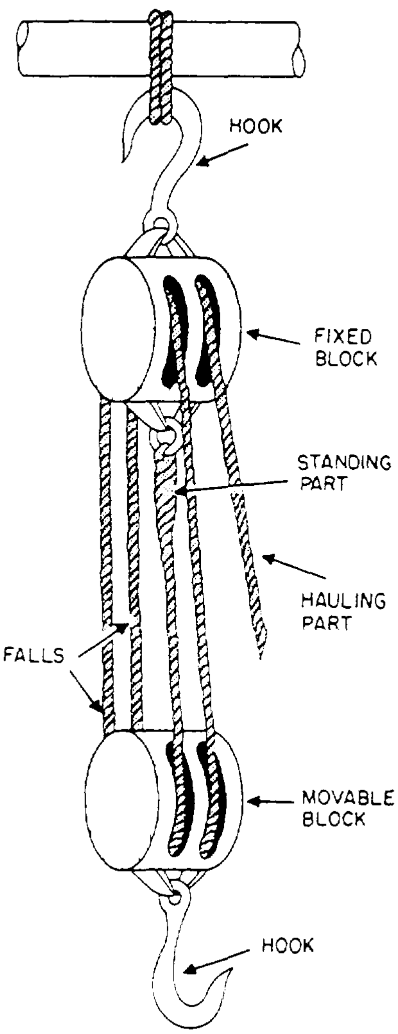


Figure 2-18.—Parts of a tackle.

In working with tackle, it helps you to understand the meaning of a few simple terms you hear used. The term *fall* means a rope, either manila or wire, reeved through a pair of blocks to form a tackle. The hauling part is the part of the fall leading from one of the blocks upon which the power is exerted. The standing part is the end of the fall of the blocks. The movable (or running) block of a tackle is the block attached to the object to be moved. The fixed (or standing) block is the block attached to a fixed object or support. When a tackle is being used, the movable block moves up and down and the fixed block remains stationary.

The *mechanical advantage* of a tackle is the term applied to the relationship between the load being lifted and the power required to lift that load. Thus, if a load of 10 pounds requires 10 pounds of power to lift it, the mechanical advantage is 1. However, if a load of 50 pounds requires only 10 pounds to lift it, then you have a mechanical advantage of 5 to 1, or 5 units of weight are lifted for each unit of power applied.

The easiest way to determine the mechanical advantage of a tackle is by counting the number of parts of the falls at the movable (or running) block. If there are two parts, the mechanical advantage is two times the power applied (less friction). A gun tackle, for instance, has a mechanical advantage of 2. Thus, to lift a 200-pound load with a gun tackle requires 100 pounds of power, disregarding friction.

By inverting any tackle, a mechanical advantage of 1 is always gained because the number of parts at the movable block is increased. By inverting a gun tackle (fig. 2-19) a mechanical advantage of 3 is attained. When a tackle is inverted, the direction of pull is difficult. This can be easily overcome by adding a snatch block, which changes the direction of pull, but does not increase the mechanical advantage.

Types Of Tackle

Various types of tackle are in common use. Three are shown in figure 2-20.

In studying each type illustrated, note the direction in which the arrows are pointing for that particular tackle. The purpose of the arrows is to indicate the sequence and direction in which the standing part of the fall is led in reeving.

A gun tackle is made up of two single sheave blocks. This tackle got its name in the old days by being used to haul muzzle-loading guns back into battery after the guns had been fired and reloaded. As stated, a gun tackle has a mechanical advantage of 2. A single luff tackle consists of a double and a single block. This type has a mechanical advantage of 3. A twofold purchase consists of two double blocks, as illustrated. It has a mechanical advantage of 4.

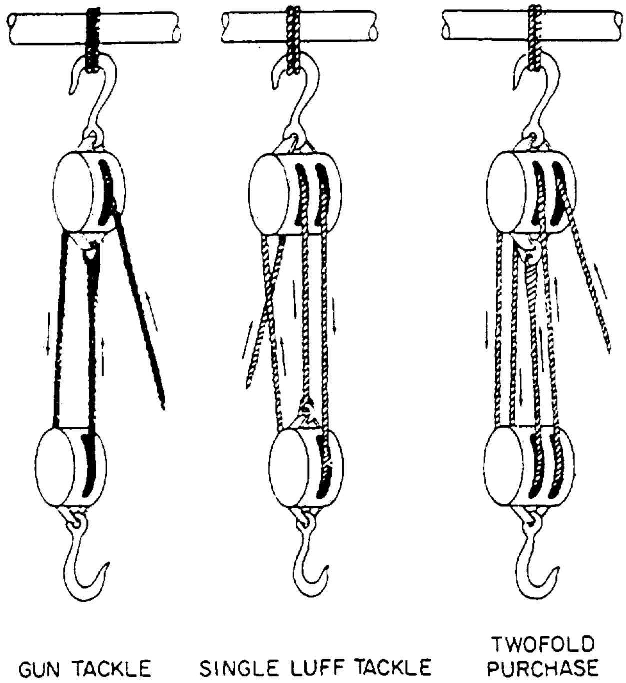


Figure 2-20.—Three common types of tackle.

Chain Hoists

Chain hoists are portable lifting devices suspended from a hook and operated by a hand chain. The one most commonly used by the ABF is the spur-geared hoist. The spur-geared hoist gains its mechanical advantage from the difference in diameter of the spur gears (reduction gear ratio) (fig. 2-21).

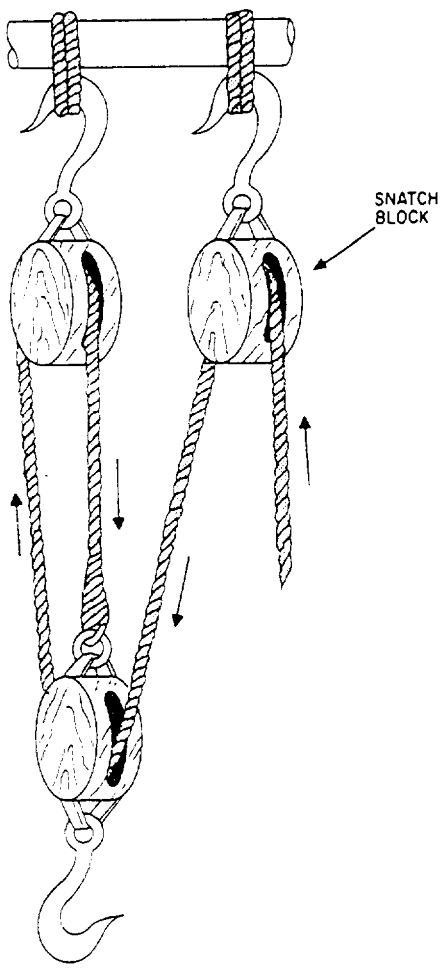


Figure 2-19.—Inverted gun tackle.

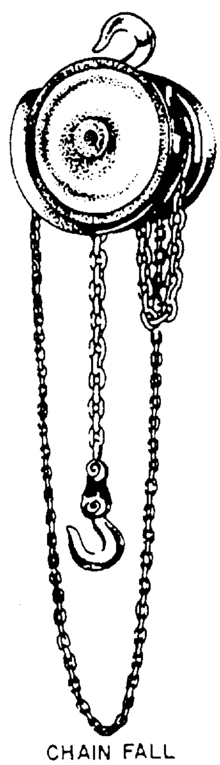


Figure 2-21.—Spur gear head chain hoist.

Two separate chains are used, one as a load chain and the other as the hand chain. The hand chain drives a pocketed chain wheel sheave that in turn drives the spur gears. The spur gears drive a single load sheave. One end of the load chain is attached to the swivel load hook. The chain then passes over the load sheave. The other end is attached to the hoist frame. A mechanical brake, consisting of a ratchet and pawl or friction disk unit plate, is used to sustain the load. To lower, pull the operating chain in the reverse direction, slipping the friction brake or releasing the ratchet-pawl device.

The worm-geared hoist and the spur gear chain hoist operate in the same way except the gearing is reduced with the use of a worm gear drive. The lead (pitch) of the worm gear makes the hoist nonoverhauling.

Lever-Operated Chain Hoist

One of the widely used pieces of lifting equipment is the ratchet hoist. In more common terms it is usually called a come-along (fig. 2-22).

The ratchet hoist (come-along) has an operating handle similar to a ratchet wrench, hence its name. It is normally light in weight and comes in a variety of sizes, depending on the job to be done. A hoist has a ratchet and pawl or a friction disk brake incorporated in its mechanism to hold the load when the handle is released. Ratchet hoists are reversible so the load may be raised or lowered. Ratchet chain hoists come equipped with the load chain either of the roller sprocket (bicycle) or link chain type.

Load chains should be lubricated and should show no indication of binding. Do not exceed the load rating of the hoist or use extensions on the ratchet lever. Inspect load chains for wear, reduction in link bar diameter, and increase in unit lengths. Use the manufacturer's data sheet or manual for reference.

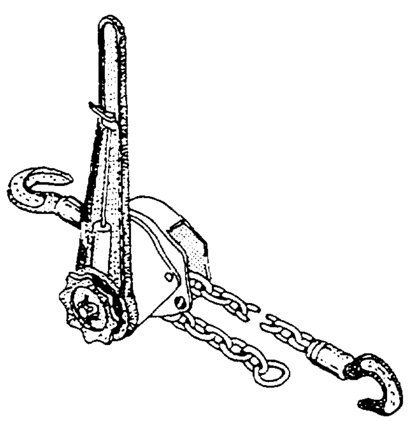


Figure 2-22.—Lever-operated chain hoist (come-along).

PIPE PATCHES

While not a tool in the normal sense of the word, pipe patches are an integral part of the ABF's toolroom. There are miles of pipes in a fuel system, and damage to this piping can result from battle, accident, or merely the wear and tear of daily use. The ABF should know how to locate and repair piping system troubles.

Repairs to piping are classified as permanent or temporary. Permanent repairs are made when the time and the material are available. Temporary are made when the correct material is not available and/or the system cannot be secured for the time needed.

Temporary repairs are usually made by securing some type of patch over the damaged section of pipe. The material used for the patch depends upon the type of piping that is being repaired. A good general rule is to make the temporary patch from the same type of material that is used for the flange gaskets in the system. Back up the patch with a piece of sheet metal, and secure the sheet metal to the pipe with bolted metal clamps or similar devices. A sealing compound may be applied between the patch and the pipe to help seal the patched area.

Jubilee pipe patches (fig. 2-23) are frequently used to stop leaks in piping. These patches may be obtained from standard stock or they may be fabricated on board ship. When making up a patch of this type, be sure to reinforce the flange so it will be strong enough to hold against the pressure of the system. The main disadvantage of the Jubilee patch is that assorted sizes must be stocked since each patch is manufactured to fit only one size of pipe.

Temporary repairs to some piping systems also may be made by using plastic patching materials. The materials required for plastic patching are furnished in a special kit.

Emergency Damage Control Metallic Pipe Repair Kit

Most water and fuel lines can be easily repaired and service restored to the system in as little time as 30 minutes by using the emergency damage control metallic pipe repair kit, often called a "plastic patch."

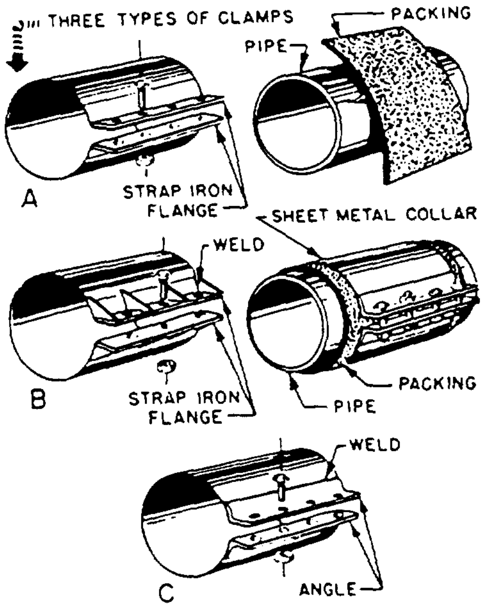


Figure 2-23.—Jubilee pipe patches.

In addition to the repair or patching of piping, certain materials are included in the kit that may be used to patch small cracks and ruptures in flat metal surfaces.

Materials in the kit may be obtained separately through appropriate supply channels whenever a need arises to replace them. You need not obtain another completely new kit. A complete kit contains the following materials:

4 cans of liquid resin, 400 grams each

4 cans of liquid hardener, 100 grams each

4 cans of paste resin, 300 grams each

4 cans of paste hardener, 75 grams each

1 piece of woven roving cloth 24” x 10”

1 piece of void cover, 8” x 36”

1 piece of polyvinyl chloride (PVC) film, 36” x 72”

1 chalk line, 1/8-lb

4 pairs of gloves

2 eyeshields

4 wooden spatulas

1 sheet of emery cloth, 9” x 11”

1 pair of scissors

4 tongue depressors

1 instruction manual

A description of the basic materials and factors related to plastics is necessary for you to more thoroughly understand the discussion of the kit and its use.

RESINS AND HARDENERS.— The liquid and paste resins are of the epoxy type. The liquid and paste hardeners are chemical compounds used to harden the resins. The resins and the hardeners are packaged in premeasured amounts. For proper mixture and better results, the complete contents of the hardener in the smaller can should be mixed with the complete contents of the resin in the larger can.

CAUTION

Do not mix hardener with resin until all preparations have been completed, and do not intermix liquid resin and paste hardener or paste resin and liquid hardener.

When the hardeners and the resins are mixed, a chemical reaction occurs that causes the mixture to harden (liquid mixture, approximately 12 minutes; paste mixture, approximately 17 minutes).

VOID COVERS.— The void cover is resin-treated glass cloth that can be cut and formed to cover the damaged area and is sufficiently rigid to give support to the patch.

WOVEN ROVING CLOTH.— The woven roving cloth is made of a short staple glass fiber woven into a thick, fluffy cloth. During the application of a plastic patch, this cloth is coated with the resin-hardener mixture and either wrapped around or placed over the damaged area. The glass cloth provides the main strength of the patch and also provides a means of applying the resin-hardener mixture.

FILM (PVC).— The plastic film is a thin, transparent polyvinyl chloride material that is used as a separating film for the flat patch to prevent the patch from sticking to the backup plate or other supports. It is called PVC. In the pipe patch it is used to cover the entire patch and keep the activated resin around the patch. Kraft wrapping paper may be used as a substitute if necessary.

Chemical Reaction of the Plastic Patch

When the resins and the hardeners are mixed together, a chemical reaction begins. This reaction is exothermic, meaning heat is given off. For about 12 to 17 minutes the temperature increases gradually until it reaches 120° to 135°F. Then a sudden, sharp increase in temperature occurs until it reaches its peak at or about 350°F. This sudden, sharp rise in temperature is known as kick-over. At this temperature, the resin-hardener mixture begins to solidify and change color from gray to light brown. The peak temperature (350°F) can be observed through the external change of the patch.

The resin-hardener mixture begins to cool slowly because the materials conduct heat poorly. After kick-over, the mixture continues to harden and increase in strength. This process is called curing. Approximately 30 minutes after kick-over (the sharp rise in temperature), the patch is strong and hard and cool enough to use. Pressure should not be restored to the system until the patch has cured. The patch is considered sufficiently cured when the bare hand can be placed on it without discomfort from heat.

Several factors contribute to the control of kick-over. The most important factor is the temperature. Both the initial temperature of the activated resin mixture and the temperature of the atmosphere affect the kick-over time. Of these two temperatures, the initial temperature of the activated resin has the greater effect. When the temperature of the resin and the hardener before mixing is increased, the kickover time decreases. Conversely, when the temperature of the resin and hardener before mixing decreases, the kick-over time increases.

A knowledge of the control of kick-over is necessary since it corresponds to the application of working time. This means, for example, that when the initial temperature of the mixture is 73°F, the patching material must be placed over the rupture within 12 minutes. Once the resin and the hardener are mixed, the chemical reaction cannot be stopped. Therefore, the patch should be completely applied before kick-over occurs.

Figure 2-24 shows the relationship of the kick-over time to the resin temperature. If you know the resin temperature at the time of mixing, you are able to determine the amount of time available to apply the patch before kick-over occurs. You can see in figure 2-24 that if the resin temperature is 80°F (point A), the kick-over will occur in less time than if the resin temperature were 60°F (point B). The difference in resin temperatures represents an application working time of 9 minutes instead of 18 minutes.

NOTE

If the initial resin temperature exceeds 80°F, the temperature should be reduced by artificial means to 73°F before mixing. This lowering of the temperature allows for additional application working time.

Advantages of the Plastic Patch

From the damage control viewpoint, the main advantages of the plastic patch are (1) versatility, (2) simplicity, (3) effectiveness, (4) speed of application, and (5) durability.

The plastic patch can be successfully applied to a variety of damaged surfaces, whether with smooth edges or jagged protruding edges. Since the plastic has excellent adhesive qualities, it can be readily applied to steel, cast iron, copper, copper-nickel, brass, bronze, and galvanized metals.

It is easy to prepare the plastic materials and to apply the plastic patch. By following the instructions outlined in the instruction manual that is included in the kit, anyone with little or no experience can readily prepare the materials and apply a plastic patch. A plastic patch is applied in much the same way as a battle dressing is used in first aid.

If the materials are properly prepared and the application procedures are followed, the plastic patch will be 100 percent effective. If leakage occurs through a plastic patch, it is likely that propr preparation and application procedures have not been followed.

The speed of application varies somewhat with the size and type of rupture, and with local working conditions. When proper preparation procedures are followed, a simple patch can be applied to a 4-inch pipe by an inexperienced crew who have had the minimum amount of training and indoctrination in 10 minutes or less. The type and the size of the rupture or the shape and the size of the structure to which the patch is applied do not materially affect the time involved in patching, but some types of damage may require more initial preparation.

The maximum period of effectiveness of a plastic patch is not known, but all indications are that a properly applied patch can last indefinitely or certainly until permanent repairs can be made. The patch is relatively inert, being seriously affected only by excessive heat and concentrated acids.

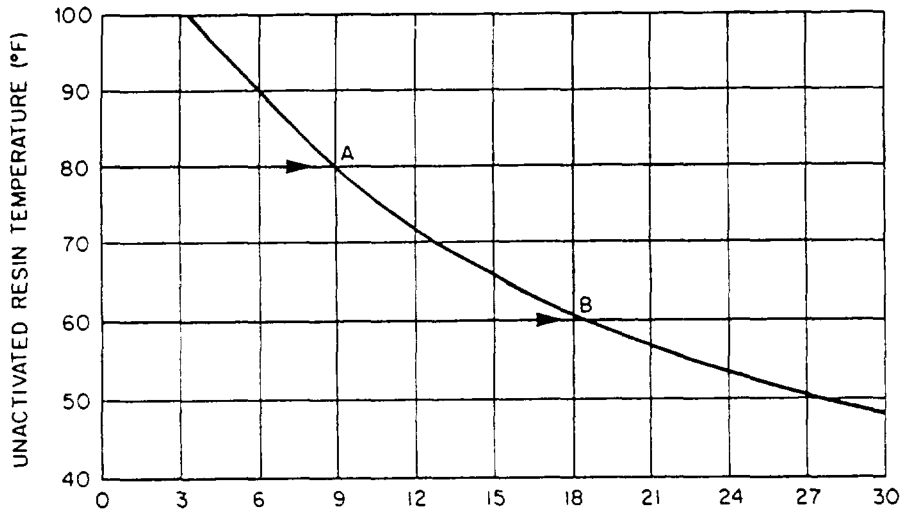


Figure 2-24.—Resin temperature vs kick-over time.

Application of Plastic Patches

In the following discussion on applying different types of plastic patches (simple, elbow, severed, and others) you can readily see that as the individual patch materials are applied, the patch becomes progressively wider. The sketch in figure 2-25 shows the relative positions of the patch materials to one another. The buildup in the patch length during application must be considered in initially determining the length of the patch to be applied. Where suitable, allow the patch to extend at least 4 to 5 inches on either side of the rupture.

In addition to the size of the rupture, the width of the patch also may depend upon the location of the rupture in the pipe system. For example, an elbow rupture may require a patch of greater width than the same size rupture would require in a straight section of pipe. Complete application instructions are included in each kit.

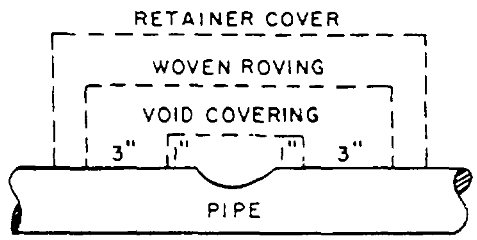


Figure 2-25.—Sequence of applied patch materials.

PREPARATION.— Before you actually apply the plastic patch, you must make the following preparations:

1. Secure or isolate the ruptured area in the piping system.

2. Remove all lagging.

3. Clean the area around the rupture and remove all grease, oil, dirt, paint, and other foreign matter. If grease or oil is present, use an approved solvent to clean around the rupture. If no approved solvent is available, scrape and wipe the surface until it is clean. When a clean surface is obtained, the surface may be further abraded for better adhesion. An abrasive cloth is furnished with the kit.

4. Ensure that all moisture and fuel are removed from the inside of the piping and the entire pipe surface is dry.

5. Where practical, the rupture should be simplified by bending or removing irregular projections. This may be done by cutting or burring.

CAUTION

Ensure no explosive conditions exist before you use spark-producing tools or burring equipment.

6. Determine the amount of materials required, such as the amount of woven roving cloth as well as the

amount of resins and hardeners. For example, a 2-inch rupture in a 2-inch diameter pipe requires 500 grams of activated resin and a length of woven roving cloth at least 25 inches long. Cut the woven roving cloth, in width, to extend at least 3 to 4 inches on either side of the rupture.

Simple Pipe Patch.— The following numbered instructions are step-by-step procedures for applying the simple pipe patch;

1. Put on the eyeshields and the gloves, then open the liquid resin can and the liquid hardener can.

2. Add hardener to the resin and mix thoroughly for approximately 2 minutes or until a uniform gray color is observed. (Note that the entire contents of the liquid hardener in the smaller can is the correct proportion for mixing with the entire contents of the larger can of liquid resin.)

3. Coat both sides of the void cover with the resin hardener mixture and tie the void cover over the rupture with chalk line (view A of fig. 2-26).

4. Lay the woven roving cloth on a clean, flat surface. Starting at one end of the cloth, pour on resin-hardener mixture and spread evenly over the entire surface of the cloth using the spatula provided in the kit. It is only necessary to impregnate one side of the woven roving cloth, but be careful to ensure the edges are well impregnated with the resin-hardener mixture.

5. Center the woven roving cloth over the void cover with the impregnated side toward the pipe and wrap around the pipe not less than three turns and preferably not more than four turns. See view B of figure 2-26.

6. Wrap the PVC film around the entire patch, making at least two complete turns. Tie the PVC film with the chalk line, starting from the center of the patch and working toward one end, making 1/2-inch spacings between spirals (view C of fig. 2-26). Tie this end securely but do not sever the line. Make one spiral back to the center of the patch, then, working to the opposite end from the center of the patch, make 1/2-inch spacings between spirals and again secure the line. After 30 to 40 minutes, the patch should be sufficiently cured to restore the pipe to service.

7. Remember that for best results the temperature of the liquid resin and the liquid hardener, before mixing, should be approximately 70°F. With a temperature of 70°F at the time of mixing, the patch cures in approximately 1 hour from the initial mixing time.

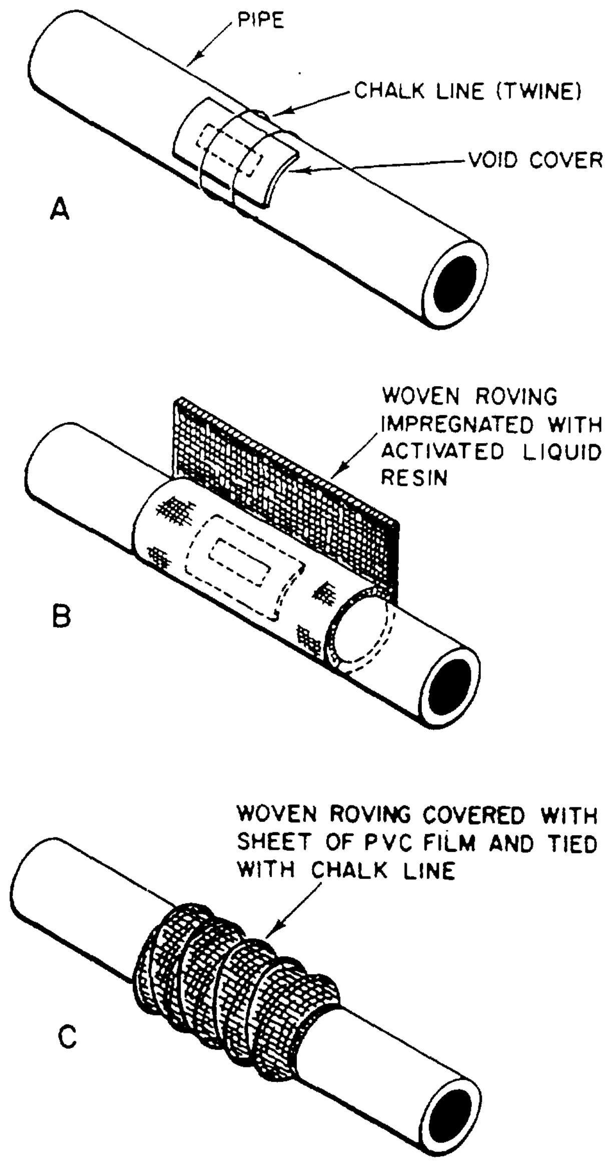


Figure 2-26.—Simple pipe patch.

8. In emergencies, if the temperature of the resins and the hardeners is below 50°F, kick-over may be accelerated by applying external heat with hot air heaters, infrared lamps, or light bulbs. The external heat must be applied gradually because excessive application of heat causes the plastic patch to be extremely porous. Before mixing, it is better to warm the resin and hardener in the can to a temperature of about 70°F.

9. Be careful not to restore pressure to the piping system too soon. In general, pressure may be restored when you can hold your hand on the entire patch area without discomfort resulting from heat. Normally this may require between 30 to 40 minutes after kick-over, or 50 to 60 minutes from the initial mixing time.

10. In emergencies, the liquid in the piping system also may be used as an artificial cooling medium 15 minutes after kick-over. This is done by circulating the liquid at very low pressure (not above 10 psi) through the system for approximately 5 minutes. This procedure generally reduces the time before full pressure can be restored to the system by about 15 minutes.

The sketch shown in figure 2-25 illustrates the relative positions of patch materials to one another. This buildup in the patch during application must be considered in initially determining the length of patch to be applied.

Elbow Patch.— The elbow patch shown in figure 2-27 is applied, using the same basic procedures as the simple patch. However, note the following exceptions:

1. The edges of the void cover are slit 2 to 3 inches at each end to conform to the contour of the pipe. See view B of figure 2-27.

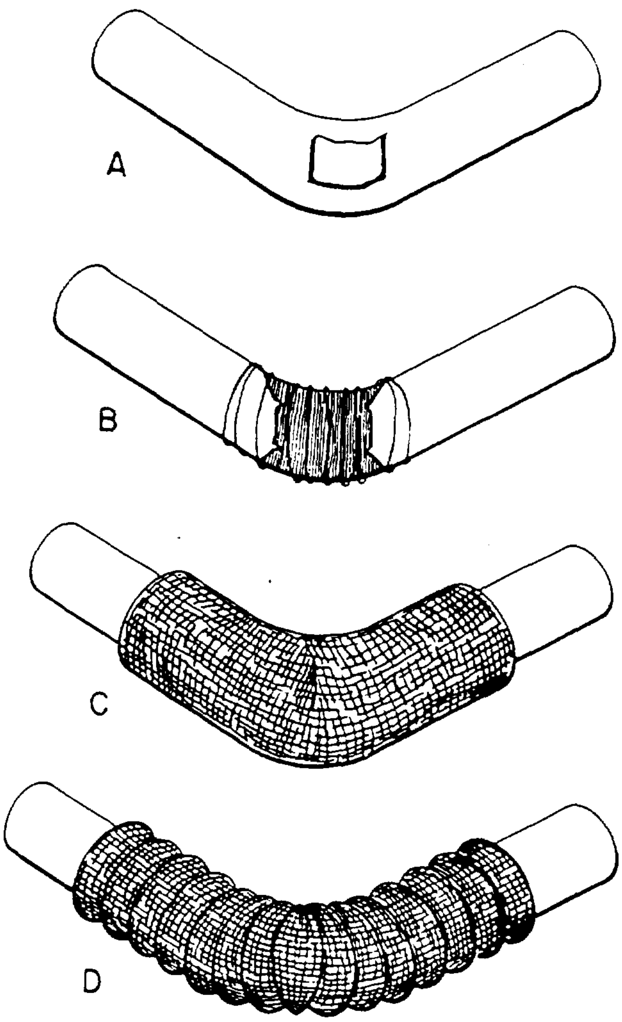


Figure 2-27.—Elbow pipe patch.

2. After the impregnated woven roving cloth has been wrapped around the pipe, use the gloved hand to shape the cloth to the contour of the pipe.

3. Then apply the PVC film and tie it with the chalk line as described for the simple pipe patch.

Severed Pipe Patch.— The severed pipe patch shown in figure 2-28 is also applied with the same basic procedures as the simple pipe patch, but this procedure too has some exceptions:

1. Where the gap exceeds 4-inches, thin sheet metal or other suitable materials may be used as a substitute for the void cover in bridging the gap. The substitute

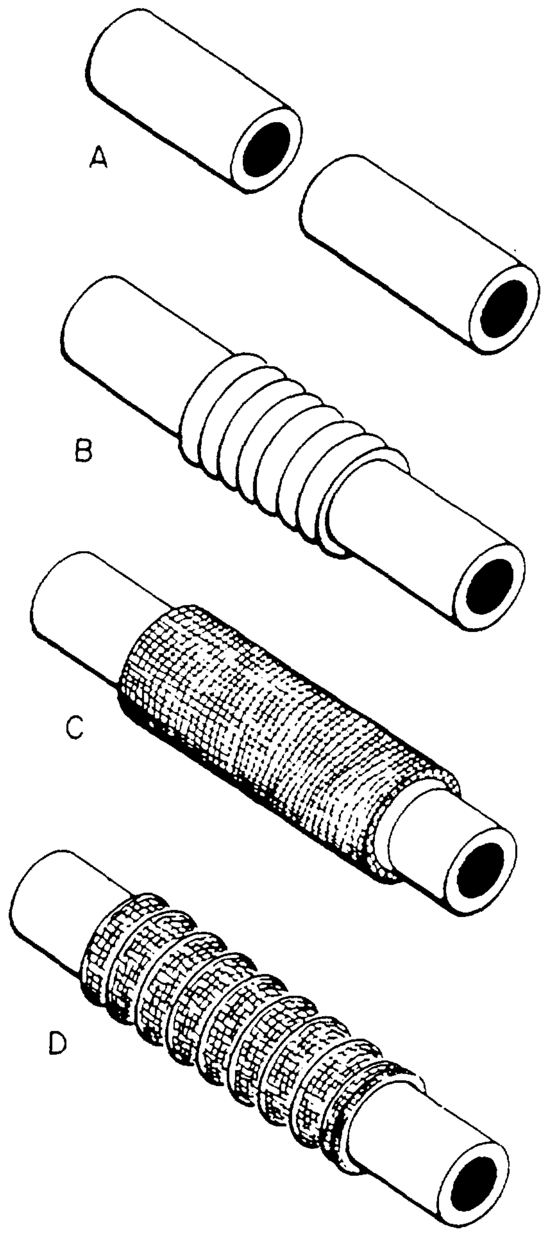


Figure 2-28.—Severed pipe patch.

material should be cut so it extends at least 2 inches on either side of the gap and should be long enough to provide one complete turn around the pipe with a possible overlap of about 2 inches. Secure the substitute material with the chalk line.

2. Cut the woven roving cloth so it extends at least 4 inches beyond the edges of the bridge material. Impregnate the cloth with the resin/hardener mixture. Wrap the cloth around the bridge materials and tie it securely as you did for the simple pipe patch.

3. Apply the PVC film and tie it securely with the chalk line as you did for the simple pipe patch.

Corn pound Patch.— When you are making repairs resulting from battle damage to piping systems, the compound-type rupture, as shown in figure 2-29, is the one you get most often. Since compound ruptures may take a variety of shapes, it becomes difficult to select a single example to fit all repairs. In most compound ruptures, it should be possible to simplify the rupture by removing butterfly edges or by cutting away the damaged section to form either a severed pipe or a simple pipe repair. When the butterfly edges or other projections cannot be removed by pounding in, cutting, or burning, a simple pipe patch may be applied with the following modifications:

1. Tie the chalk line firmly between the jagged edges (view B of fig. 2-29) crisscrossing as much as possible. This chalk line acts as a support for the woven roving cloth and keeps it from falling into the void. No void cover is used in this example as it would be impractical to cut a void cover to suit the jagged edges shown in view A of figure 2-29.

2. A small piece of impregnated woven roving cloth (view C of fig. 2-29) is folded and laid in the void where it helps to build up the mass and acts as an insulator.

3. Apply the woven roving cloth (view D of fig. 2-29) cut to the appropriate length and width over the small folded piece of woven roving cloth, and tie it firmly as outlined previously for the simple pipe patch.

Flange Patch.— The flange patch (fig. 2-30) is also applied similarly to the simple pipe patch, but it has some modifications in the application procedure.

1. As illustrated in view B of figure 2-30, the void cover is cut into an H shape, impregnated with the resin-hardener mixture, inserted into the void, and tied securely in place.

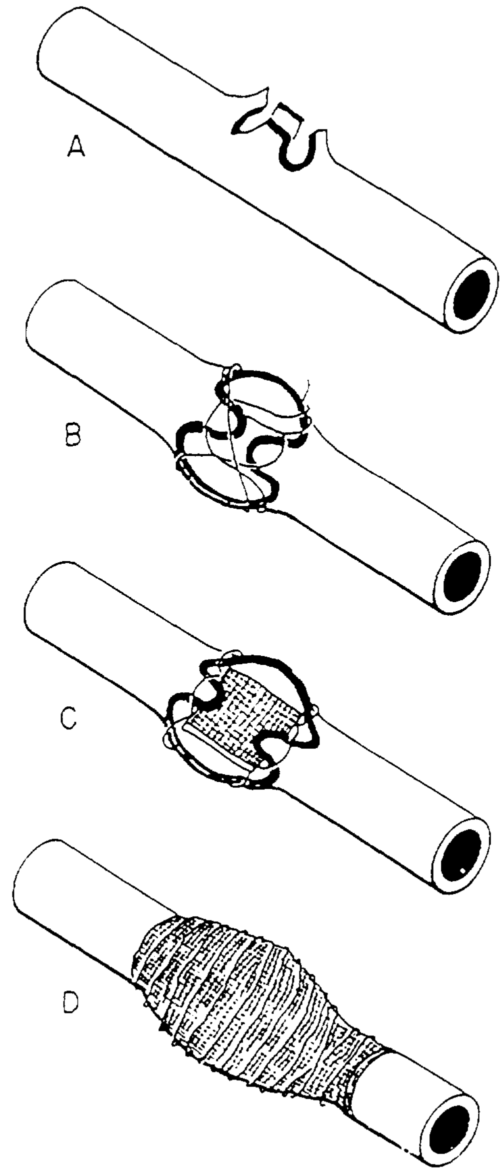


Figure 2-29.—Compound rupture patch, edges not removed.

2. Four pieces of woven roving cloth are cut long enough to make one complete turn around the pipe and overlap 1 inch. These four pieces of woven roving cloth are cut in an H shape, but the center pieces are not cut away. Instead, they are folded up over the edges of the flange.

3. Impregnate the separate pieces of woven roving cloth with the resin-hardener mixture and place over the rupture, as shown in view C of figure 2-30.

4. Apply the PVC film and tie down firmly, starting at one end and working up to the flange. Make several windings through the gap in the flange in the

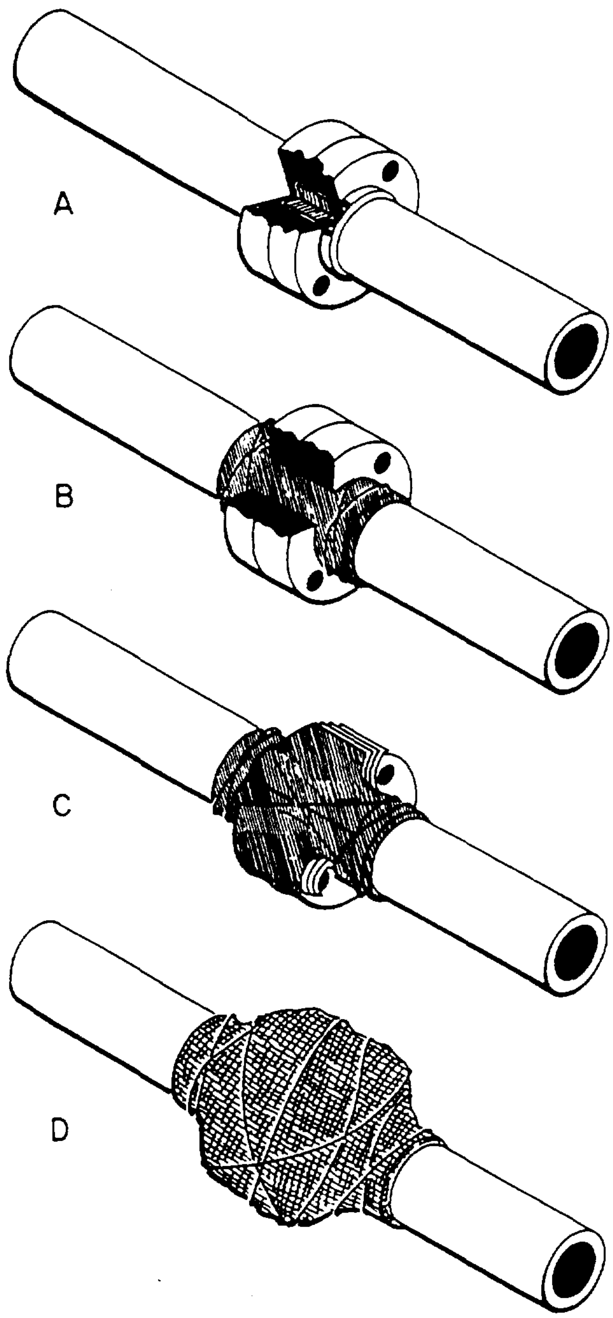


Figure 2-30.—Flange rupture patch.

shape of an X to have the woven roving cloth conform to the center of the rupture and the flange edges. Continue to the opposite end of the patch and tie securely in place.

SAFETY RULES.— The following safety precautions should be observed by all personnel when they are working with plastic materials:

1. Provide forced intake and exhaust ventilation; this is particularly important when heat and resultant fumes are given off.

2. Wear long-sleeved coveralls, long-sleeved neoprene gloves, knee-high rubber boots, and goggles.

3. Immediately relieve and treat anyone evidencing sensitization.

4. Wash hands frequently. (Personal cleanliness is your most important and effective protection.)

5. Do not expose yourself to or breathe the noxious fumes given off during cure.

6. Avoid spilling plastic materials. Keep kraft paper in areas where material is likely to spill or drip.

7. Keep the resin and liquid hardener off skin areas, wherever possible. Use protective ointment. If contaminated, remove material as soon as possible, using soap and hot water.

8. Keep the resin and liquid hardener out of the eyes. If contaminated, immediately flush with water for at least 15 minutes and obtain medical treatment.

9. Wash gloves and goggles immediately after each use with a good detergent.

Aboard ship, these precautions should be taken as far as possible but not to such an extent as to delay vital repair measures. Reasonable care in the handling of materials and thorough washing after their use should suffice. Since it appears that resins and liquid hardeners do not have primary irritant qualities, they maybe used aboard ship without any trouble, except a possible rare case of sensitivity.

An ideal plastic patch is one that can be applied and cured in the shortest time possible and maintains the desired tightness. The primary factor controlling kick-over time is the temperature of the resin and hardener before mixing. To effect the cure in the shortest time possible, you must contain the heat generated in the patch. This is done by creating a mass about the break in the pipe or bulkhead rupture by using an impregnated woven roving cloth. You can see that the correct amount of mass is necessary to have an effective patch. It is also important that the patch cool readily, for you cannot restore pressure to the system until the patch cools to about 150°F. The net result is that you buildup a mass about the rupture that gives you the patch with the most desirable characteristics in the shortest time possible.

PORTABLE POWER TOOLS

LEARNING OBJECTIVES: Identify portable power tools used by the ABF. Explain the use and care of power tools. State the safety precautions required when using power tools.

ABFs are frequently required to use portable power tools in the maintenance of assigned areas that are exposed to the weather. Power tools, when used properly and efficiently, are an enormous time and manpower saver, especially when a large painted or rusted surface requires scaling and represervation. Before using electric portable tools, be sure the proper voltage is supplied. This information can be found on the nameplate permanently attached to the tool. Electric tools of all types used in the Navy are required to have a proper ground capability. If doubt exists whether or not a good ground has been established, request the services of an Electrician's Mate to check it out before applying power to the tool. NEVER VARY the manufacturer's recommended voltage. SAFETY IS PARAMOUNT.

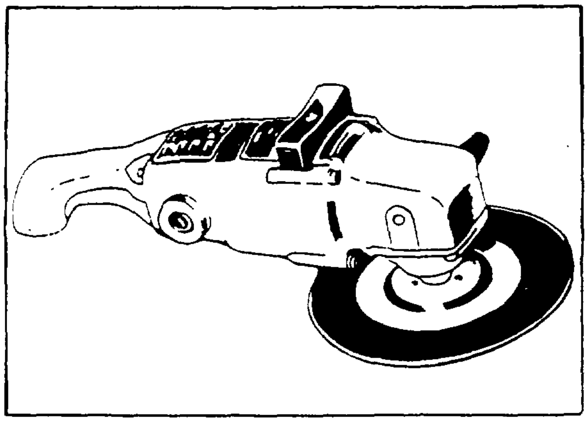


Figure 2-31.—Portable electric sander.

When pneumatic tools are used, the air supply pressure specified on the nameplate should always be maintained. Insufficient air pressure causes the tool to function improperly. Excessive air pressure results in damage to the tool and the person operating the tool may not be able to control it properly.

REMEMBER that tools can cut through rust, paint, metal, arms, and legs. Give your full attention while operating any power tool and never distract anyone who is using power equipment.

PORTABLE ELECTRIC DRILL

The electric drill is a versatile item of equipment. It is probably used more than any other portable electric tool. It can be used for drilling holes in wood or metals, mixing paint, and buffing small items with the proper attachments, as well as a variety of other uses.

The average size electric drill has a 1/4-inch capacity, with a three-fingered chuck tightened with a chuck key. The chuck key is usually taped to the electric cord about 18 inches from the drill itself to allow it to be used in the chuck without being removed from the cord. Heavier drills are larger in appearance and weight but have larger motors and

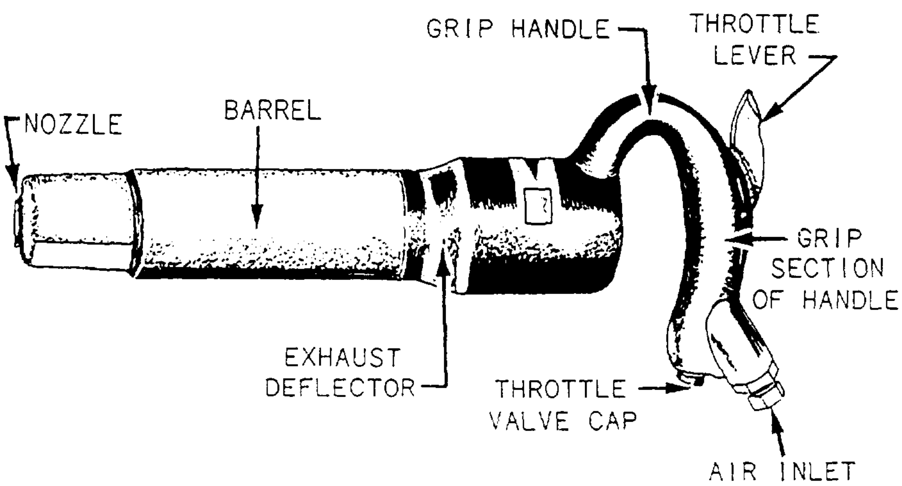


Figure 2-32.—Pneumatic chipping hammer.

chucks. In general, the larger the drill (and motor), the slower the rpm, which provides the needed extra torque to twist a greater size drill bit.

CAUTION

Unplug the drill before attempting to tighten or remove drill bits.

PORTABLE ELECTRIC OR NEUMATIC OPERATED SANDER

The power sander (fig. 2-31) is one of the most desirable tools for scaling rust, removing paint, and smoothing decks and bulkheads before painting. The design of the portable power sander is much like that of the electric drill motor with the addition of the sanding disk attached at right angles. The average size disk sander used in the Navy is either 7 or 9 inches.

PNEUMATIC CHIPPING HAMMER

The pneumatic chipping hammer (fig. 2-32) is another tool useful to the ABF when scaling large areas in preparation for repainting. Air pressure supply should be maintained to the manufacturer's recommended working pressures found on the nameplate attached to the tool. Never point the pneumatic chipping hammer at another person or yourself while air pressure is supplied to the tool. Personal injury could occur if the chisel was expelled at high speed from the scaling hammer.

ROTARY IMPACT SCALER

The rotary impact scaler (fig. 2-33) is a scaling and chipping tool, sometimes called a jitterbug. It is electric or pneumatic powered and has a bundle of cutters mounted on either side. In use, it is pushed along the surface to be scaled with the rotating chippers doing the work. Replacement bundles of cutters are available.

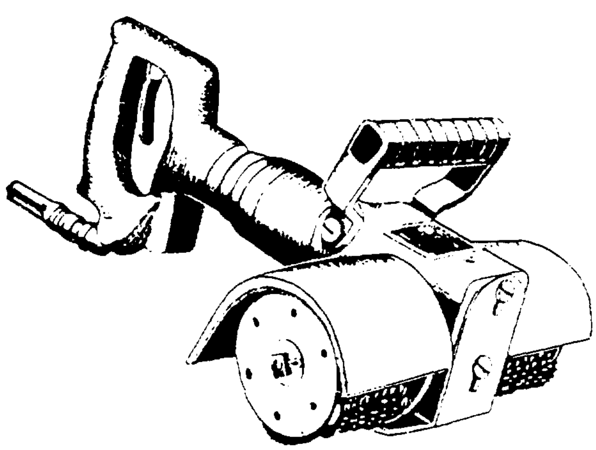


Figure 2-33.—Rotary impact scaler.

NEEDLE IMPACT SCALER

The needle impact scaler (fig. 2-34) has needlelike attachments that fit into one end. It is often called a needle-gun. This tool is used in conjunction with the rotary scaler and can clean out (scale) corners not reached by the other tool.

PRECISION MEASURING EQUIPMENT

LEARNING OBJECTIVES: Identify precision measuring equipment used by the ABF. Explain the use and care of precision measuring equipment.

As an ABF, you will be using measuring tools that read in the thousandths (0.001). On PMS and in major maintenance work, you will be required to use torque wrenches, micrometers, telescoping gages, vernier calipers, and dial indicators. Aligning pumps, checking shafts for wear, and checking bearings' inside and outside diameters are just a few places where these tools are used. We will now go through the selection and use of the proper tool for the job at hand.

TORQUE WRENCHES

There are times when, for engineering reasons, a definite force must be applied to a nut or bolt head. In such cases a torque wrench must be used. For example, equal force must be applied to all the head bolts of an engine. Otherwise, one bolt may bear the brunt of the force of internal combustion and ultimately cause engine failure.

The three most commonly used torque wrenches are the deflecting beam, dial indicating, and

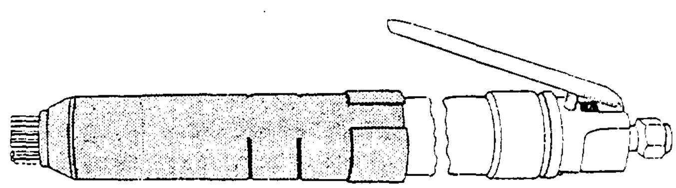


Figure 2-34.—Needle impact scaler (needle-gun).

micrometer setting types (fig. 2-35). When using the deflecting beam and the dial indicating torque wrenches, the torque is read visually on a dial or scale mounted on the handle of the wrench.

To use the micrometer setting type, unlock the grip and adjust the handle to the desired setting on the micrometer-type scale, then relock the grip. Install the required socket or adapter to the square drive of the handle. Place the wrench assembly on the nut or bolt and pull in a clockwise direction with a smooth, steady motion. (A fast or jerky motion will result in an improperly torqued unit.) When the torque applied reaches the torque value, indicated on the handle setting, a signal mechanism will automatically issue an audible click, and the handle will release or "break," and move freely for a short distance. The release and free travel are easily felt, so there is no doubt about when the torquing process is complete.

Manufacturers' and technical manuals generally specify the amount of torque to be applied. To assure getting the correct amount of torque on the fasteners, it is important that you use the wrench properly according to manufacturers' instructions.

Use that torque wrench that will read about mid-range for the amount of torque to be applied. BE SURE THAT THE TORQUE WRENCH HAS BEEN CALIBRATED BEFORE YOU USE IT. Remember, too, that the accuracy of torque measuring depends a lot on how the threads are cut and the cleanliness of the threads. Make sure you inspect and clean the threads. If the manufacturer specifies a thread lubricant, it must be used to obtain the most accurate torque reading. When using the deflecting beam or dial indicating wrenches, hold the torque at the desired value until the reading is steady.

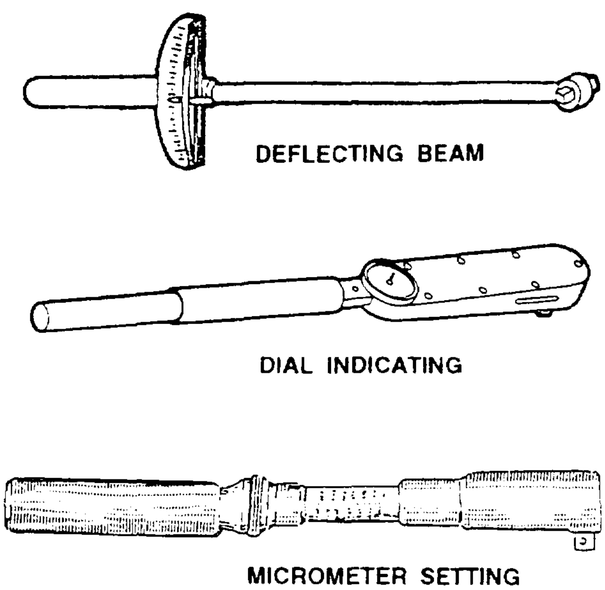


Figure 2-35.—Torque wrenches.

Torque wrenches are delicate and expensive tools. The following precautions should be observed when using them:

1. When using the micrometer setting type, do not move the setting handle below the lowest torque setting. However, place it at its lowest setting before returning it to storage.

2. Do not use the torque wrench to apply greater amounts of torque than its rated capacity.

3. Do not use the torque wrench to break loose bolts that have been previously tightened.

4. Do not drop the wrench. If dropped, the accuracy will be affected.

5. Do not apply a torque wrench to a nut that has been tightened. Back off the nut one turn with a nontorque wrench and retighten to the correct torque with the indicating torque wrench.

6. Calibration intervals have been established for all torque tools used in the Navy. When a tool is calibrated by a qualified calibration activity at a shipyard, tender, or repair ship, a label showing the next calibration due date is attached to the handle. This date should be checked before a torque tool is used to ensure that it is not overdue for calibration.

MICROMETERS

The type of micrometers commonly used are made so the longest movement possible between the spindle and the anvil is 1 inch. This movement is called the range. For example, a 2-inch micrometer has a range from 1 inch to 2 inches, and only measures work between 1 and 2 inches thick. Therefore, you must first determine the approximate size, to the nearest inch, of the piece to be measured and then select the proper size micrometer. The size of a micrometer indicates the size of the largest work it can measure.

Outside Micrometer

The nomenclature of an outside micrometer is illustrated in figure 2-36.

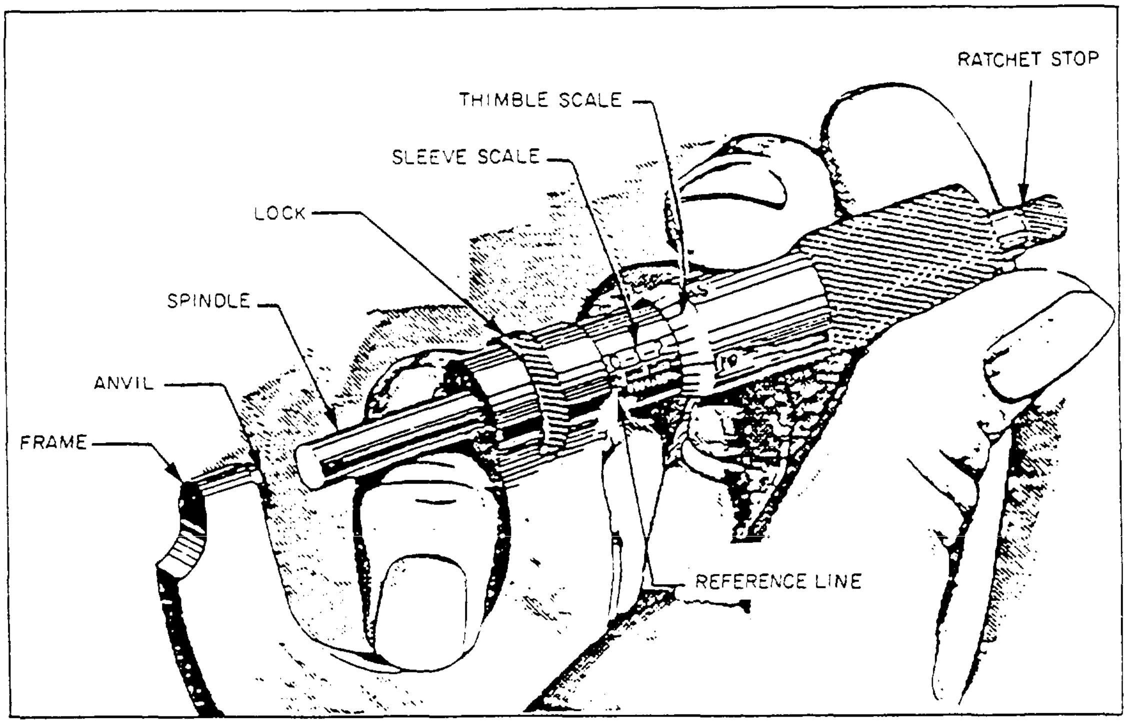


Figure 2-36.—Nomenclature of an outside micrometer.

The sleeve and thimble scales of a micrometer (fig. 2-37) have been enlarged and laid out for demonstrational purposes. To understand these scales you need to know that the threaded section on the spindle, which revolves, has 40 threads per inch. Therefore, every time the thimble completes a revolution, the spindle advances or recedes 1/40 inch or 0.025 inch.

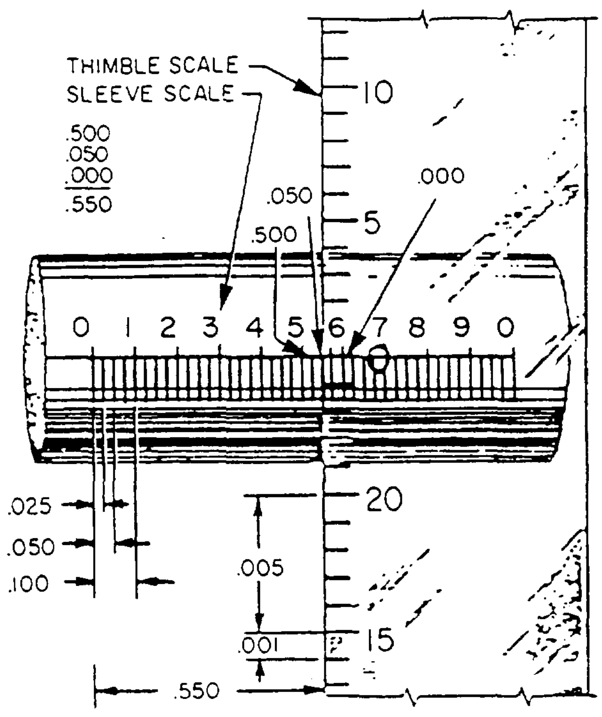


Figure 2-37.—Sleeve and thimble scales of a micrometer.

Note the horizontal line on the sleeve is divided into 40 equal parts per inch. Every fourth graduation is numbered 1, 2, 3, 4, and so on, representing 0.100 inch, 0.200 inch, and so on. When you turn the thimble so its edge is over the first sleeve line past the 0 on the thimble scale, the spindle has opened 0.025 inch. If you turn the spindle to the second mark, it has moved 0.025 inch plus 0.025 inch or 0.050 inch.

When the beveled edge of the thimble stops between graduated lines on the sleeve scale, you must use the thimble scale to complete your reading. The thimble scale is divided into 25 equal parts; each part or mark represents 1/25 of a turn. And 1/25 of 0.025 inch equals 0.001 inch. Note in figure 2-37, every fifth line on the thimble scale is marked 5, 10, 15, and so on. The thimble scale permits you to take very accurate readings to the thousandths of an inch.

The thimble is turned far enough to expose the 7 on the sleeve scale, but <u>not</u> far enough to expose the first mark after the 7. Therefore, the measurement must be between 0.700 inch and 0.725 inch. Exactly how far between 0.700 inch and 0.725 inch must be read on the thimble scale.

The enlarged scale in figure 2-38 can help you understand how to take a complete micrometer reading to the nearest thousandth of an inch.

As you can see, the thimble has been turned through 12 spaces of its scale, and the 12th graduation is lined up with the reference line on the sleeve. When the value on the sleeve scale is added to the value on the thimble scale that is lined up with the reference line on the sleeve scale, the space between the anvil and spindle must be 0.712 inch (seven hundred and twelve-thousandths of an inch).

Occasionally you attain a reading in which the horizontal reference line of the sleeve scale falls between two graduations on the thimble scale, as shown in figure 2-39. Note the horizontal reference line is closer to the 15 mark than the 14 mark. To read this measurement to THREE decimal places, simply round off to the 15 mark as shown in example A of figure 2-39. To read this measurement to FOUR decimal places, estimate the number of tenths of the distance between thimble scale graduations the horizontal reference line has fallen. Each tenth of this distance equals one ten-thousandth (0.0001) of an inch. Add the ten-thousandths to the reading as shown in example B of figure 2-39.

Reading the Vernier Scale on a Micrometer

Many times you are required to work to exceptionally precise dimensions. Under these conditions it is better to use a micrometer that is accurate to ten-thousandths of an inch. This degree of accuracy is obtained by the addition of a vernier scale.

The vernier scale of a micrometer (fig. 2-40) furnishes the fine readings between the lines on the

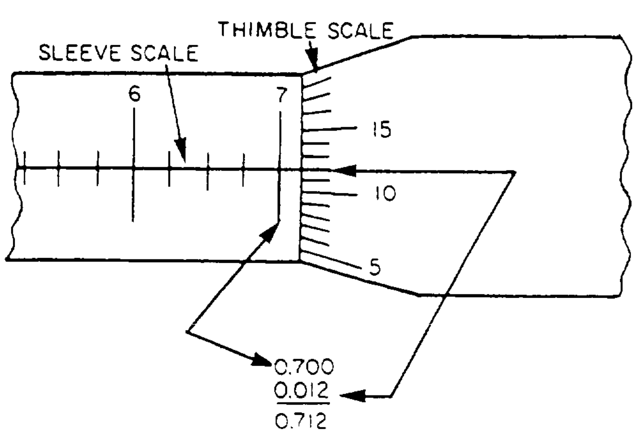


Figure 2-38.—Enlarged micrometer scale.

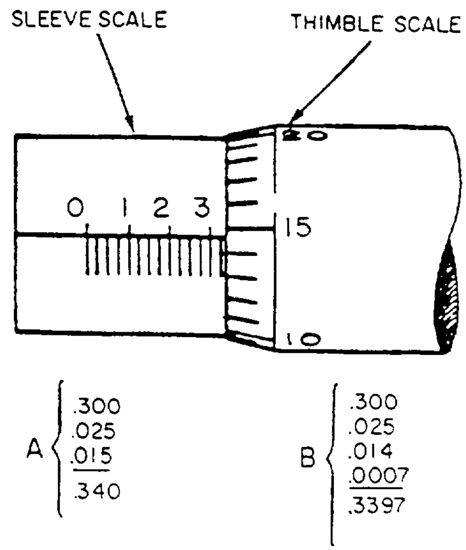


Figure 2-39.—Estimating a micrometer reading.

thimble rather than requiring you to interpolate (or estimate) the reading. The 10 spaces on the vernier are equivalent to 9 spaces on the thimble. Therefore, each unit on the vernier scale is equal to 0.0009 inch and the difference between the sizes of the units on each scale is 0.0001 inch.

When a line on the thimble scale does not coincide with the horizontal reference line on the sleeve, you can determine the additional spaces beyond the readable thimble mark by finding which vernier mark matches up with a line on the thimble scale. Add this

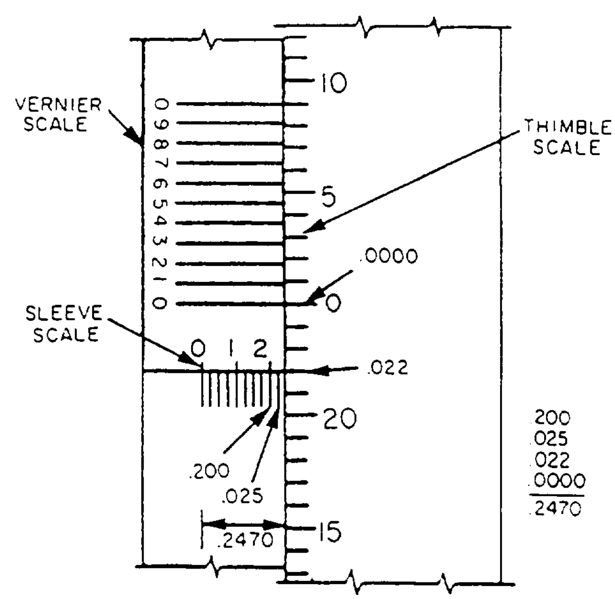


Figure 2-40.—Vernier scale of a micrometer.

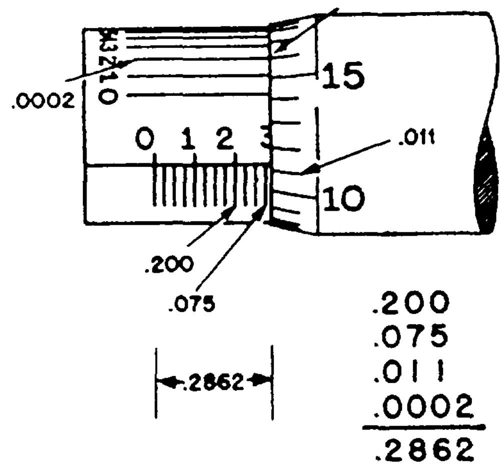


Figure 2-41.—Reading a vernier scale micrometer.

number, as that many ten-thousandths of an inch, to the original reading. In figure 2-41, see how the second line on the vernier scale matches up with a line on the thimble scale.

This means that the 0.011 mark on the thimble scale has been advanced an additional 0.0002 beyond the horizontal sleeve line. When you add this to the other readings, the reading is 0.200 + 0.075 + 0.011 + 0.0002 or 0.2862, as shown.

Inside Micrometer

The inside micrometer, as the name implies, is used for measuring inside dimensions, such as pump casing wearing rings, cylinders, bearings, and bushings. Inside micrometers usually come in a set that includes a micrometer head, various length spindles (or extension rods) that are interchangeable, and a spacing collar that is 0.500 inch in length. The spindles (or extension rods) usually graduate in 1-inch increments of range; for example, 1 to 2 inches, 2 to 3 inches (fig. 2-42).

The 0.500 spacing piece is used between the spindle and the micrometer head so the range of the micrometer can be extended. A knurled extension handle is usually furnished for obtaining measurements in hard-to-reach locations.

To read the inside micrometer, read the micrometer head exactly as you would an outside micrometer, then add the micrometer reading to the rod length (including spacing collar, when installed) to obtain the total measurement.

When the 1- to 2-inch spindle is used, and the sleeve and thimble scales are set to 0.00 inch, the distance between the face of the anvil and the face of the spindle is exactly 1.00 inch.

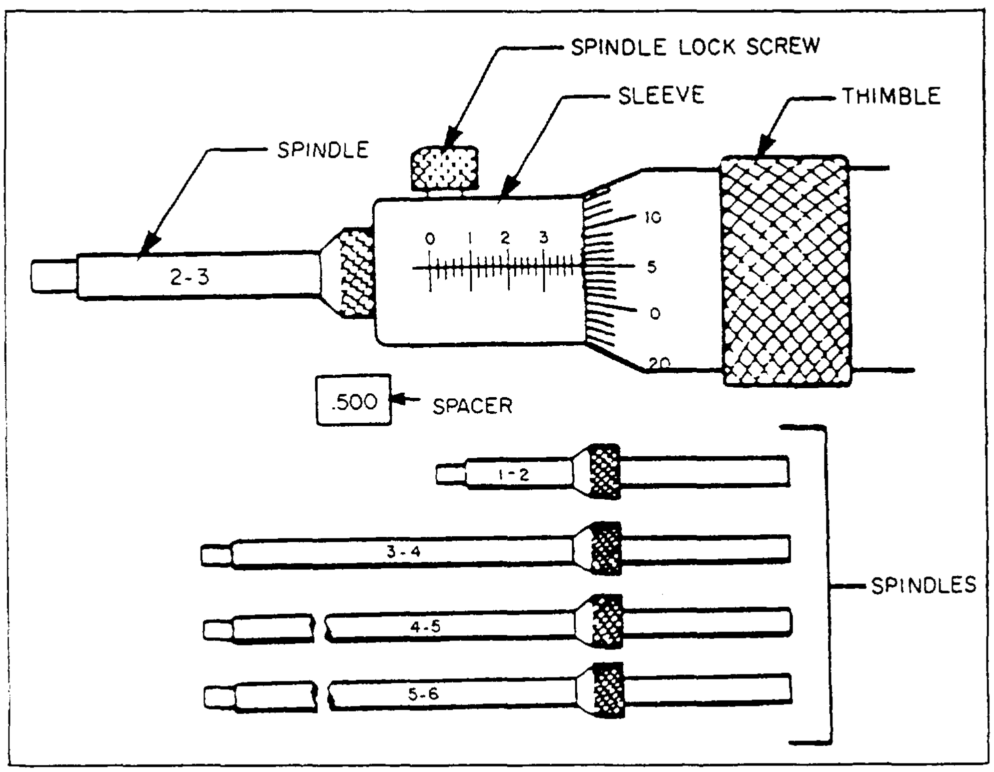


Figure 2-42.—Inside micrometer set.

VERNIER CALIPER

The vernier caliper (fig. 2-43) consists of an L-shaped member with a scale engraved on the long shank. A sliding member is free to move on the bar and carries a jaw that matches the arm of the L. The vernier scale is engraved on a small plate that is attached to the sliding member.

The vernier caliper can provide very accurate measurements over a large range. It can be used for both internal and external measurement. Some models have a depth reading feature in addition to the internal and external measurements.

In using the vernier caliper, you must be able to read a vernier scale. Figure 2-44 shows a bar 1 inch long divided by graduations into 40 parts, so each graduation indicates one-fortieth of an inch (0.025 inch). Every fourth graduation is numbered; each number indicates tenths of an inch (A x 0.025 inch). The vernier, which slides along the bar, is graduated into 25 divisions; these together are as long as 24 divisions on the bar. Each division of the vernier is 0.001 inch smaller than each division of the bar. Verniers that are calibrated as explained previously are known as English-measure verniers. The metric-measure vernier is read the same, except that the units of measurement are in millimeters.

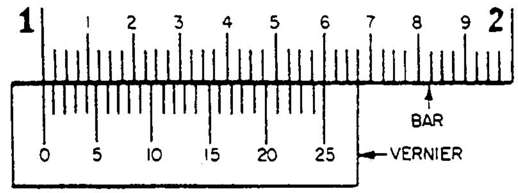


Figure 2-44.—English-measure vernier scale.

Taking Outside Measurements with the Vernier Caliper

To measure the distance between outside surfaces or the outside diameter of a round object (such as sound stock or a shaft), steady the object with one hand and hold the caliper in one hand as shown in figure 2-45. In the figure, the clamping screws are at A and B; the horizontal adjustment screw nut is at C. With A and B loose, slide the movable jaw toward the piece being measured until it is almost in contact. Then tighten clamping screw A to make the fine adjusting nut C operative. Using the fine adjusting nut, adjust the movable jaw to the proper feel, then secure the setting by tightening clamping screw B. The reading can then be taken as previously described.

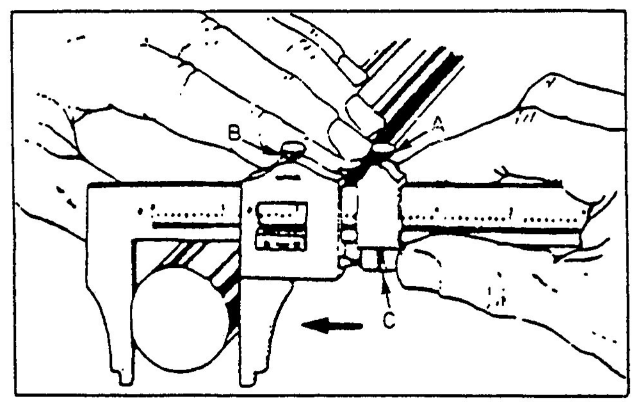


Figure 2-45.—Taking an outside measurement with a vernier caliper.

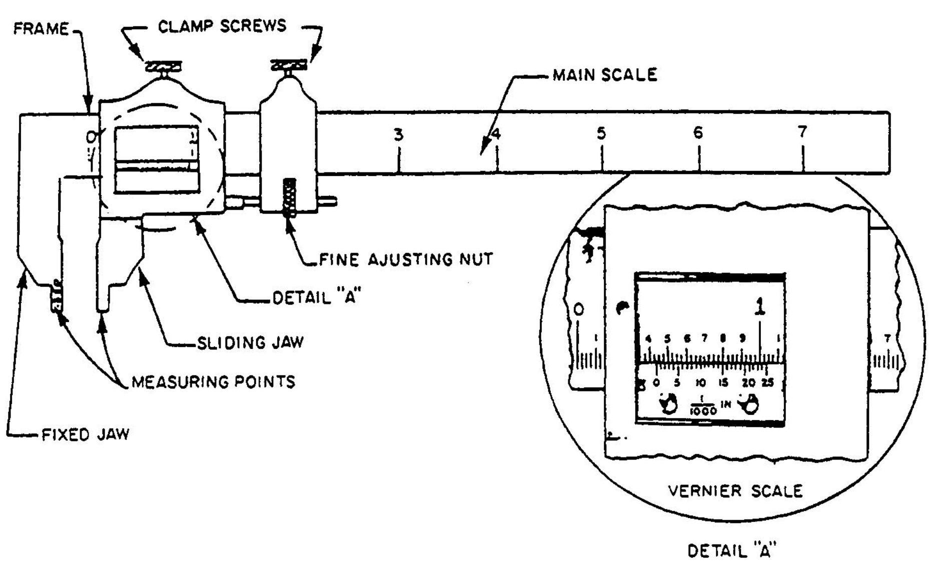


Figure 2-43.—Vernier caliper.

Taking Inside Measurements with the Vernier Caliper

To measure the distance between inside surfaces, or the inside diameter of a hole, with a vernier caliper, use the scale marked INSIDE. Figure 2-46 shows the measuring points in place.

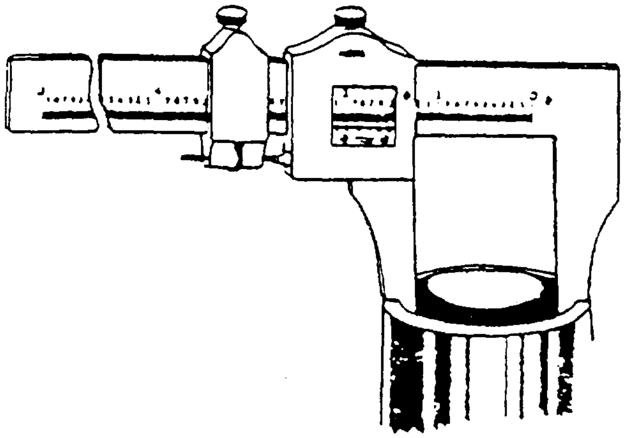


Figure 2-46.—Taking an inside measurement with a vernier caliper.

Remember that if you are using a vernier caliper with both metric and English scales, the scales appear on opposite sides of the caliper and apply only to outside measurements. Then, to get correct inside measurements, you add to the actual reading the measuring point allowance for the size of caliper you are using. The measuring point allowance is usually etched on the measuring point of the fixed jaw (refer to fig. 2-43), or it is contained in the manufacturer's instructions. So if the actual reading from the vernier scale is 1.026 inch and the measuring point allowance is 0.250 inch, the inside measurement would be 1.276 inch.

DEPTH GAGE

A depth gage is an instrument for measuring the depth of holes, slots, counterbores, recesses, and the distance from a surface to some recessed part. The RULE DEPTH GAGE and the MICROMETER DEPTH GAGE (fig. 2-47) are the most commonly used in the Navy.

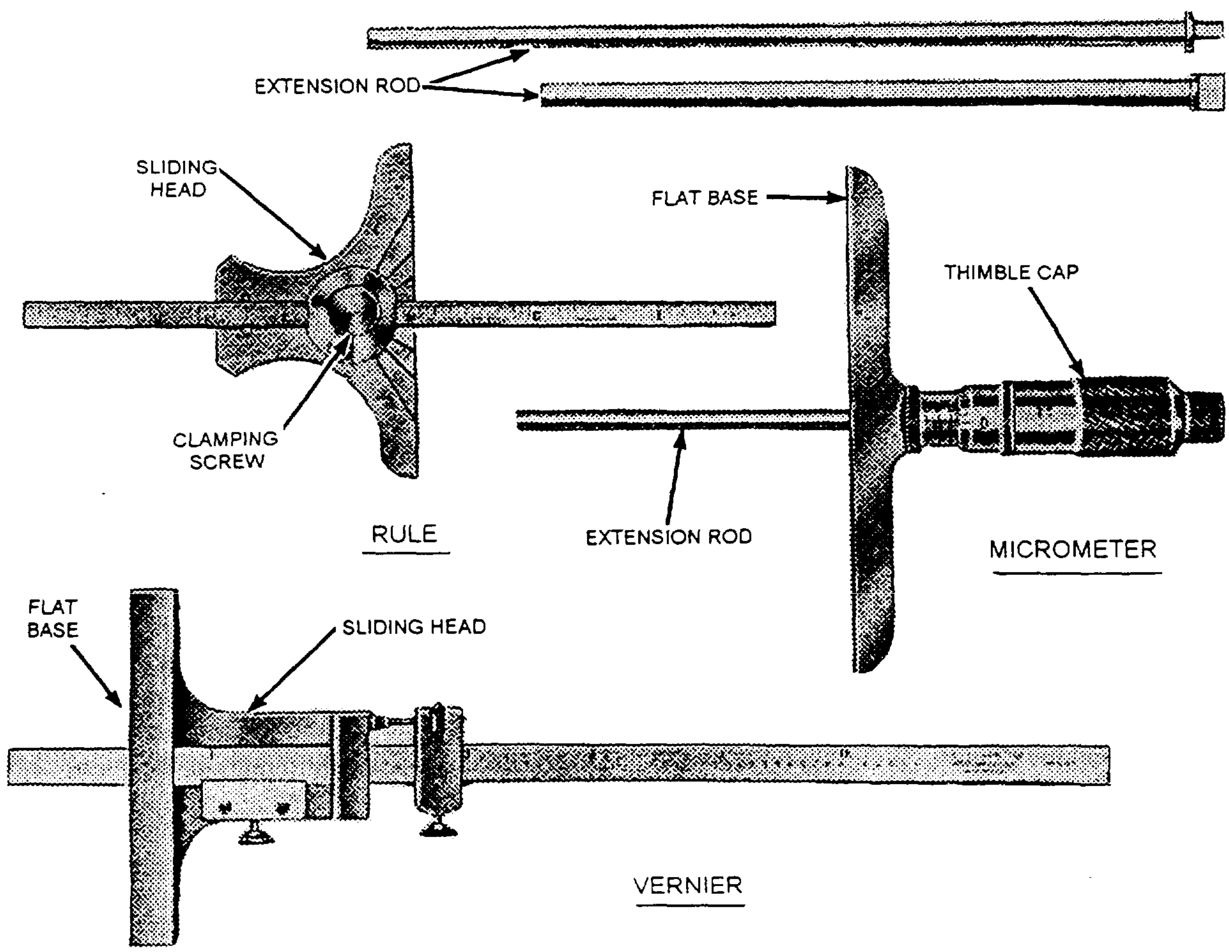


Figure 2-47.—Types of depth gages.

The rule depth gage is a graduated rule with a sliding head designed to bridge a hole or slot and to hold the rule perpendicular to the surface on which the measurement is taken. This type has a measuring range of 0 to 5 inches. The sliding head has a clamping screw so it may be clamped in any position. The sliding head has a flat base that is perpendicular to the axis of the rule and ranges in size from 2 to 2 5/8 inches in width and from 1/8 to 1/4 inch in thickness.

The micrometer depth gage consists of a flat base attached to the barrel (sleeve) of a micrometer head. These gages have a range from 0 to 9 inches, depending on the length of extension rod used. The hollow micrometer screw (the threads on which the thimble rotates) itself has a range of either 1/2 or 1 inch. Some have a ratchet stop. The flat base ranges in size from 2 to 6 inches. Several extension rods are normally supplied with this type of gage. To measure the depth of a hole or slot with reasonable accuracy, use a depth gage as shown in figure 2-48, view A. Hold the body of the depth gage against the surface from which the depth is to be measured and extend the scale into the hole or slot. Tighten the set-screw to maintain the setting. Withdraw the tool from the work and read the depth on the scale.

To measure the depth of a hole or slot with more accuracy than is possible with an ordinary depth gage, place a vernier depth gage over the slot as shown in figure 2-48, view B. Notice the clamping screws are at X and Y; the horizontal adjusting screw nut is at Z. With X and Y loose, slide the scale down into the slot being measured until it is almost in contact. Then tighten X to make Z operative. With Z, adjust the scale to the proper feel and secure the setting with Y. By proper feel we mean the adjustment at which you first notice contact between the end of the scale and the bottom of the slot. Then read the setting as described under "Reading a Vernier Scale."

To set the vernier depth gage to a particular setting, loosen both setscrews at X and at Y and slide the scale through the gage to the approximate setting. Tighten the sets crew at X, turn the knurled nut at Z until the desired setting is made, and tighten the setscrew at Y to hold the setting.

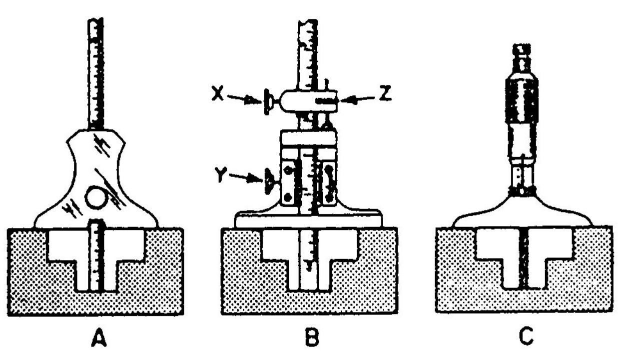


Figure 2-48.—Using depth gages.

To measure the depth of a hole or slot, as shown in figure 2-48, view C, with more accuracy than is possible with either an ordinary depth gage or a vernier depth gage, place a micrometer depth gage over the slot and adjust the thimble until the contact of the spindle causes the ratchet stop to slip. Remove the micrometer from the work and read the micrometer. Remember, if extension rods are used, the total depth reading will be the sum of the length of the rods plus the reading on the micrometer.

DIAL INDICATOR

The dial indicator is used in several different ways to measure the amount of deviation (or runout) in revolving or rotating parts. Accurate shaft-to-shaft alignment is impossible without using a dial indicator.

Dial indicators are supplied with various fittings, links, and adapters. Additionally, special application hardware is available. Figure 2-49 illustrates the basic hardware of a dial indicator set and two different types of dial heads. The dial scale is usually graduated in thousandths of an inch and has an adjustable bezel around it. The scale of a dial indicator usually reads plus numbers to the right of zero and minus numbers to the left of zero.

The typical setup for checking the trueness of a shaft, using a dial indicator and vee blocks (or roller blocks), is to place the shaft in the vee blocks, mount the magnetic base or clamp attachment (whichever is the most appropriate) with the swivel post and dial head attached to a solid surface. Adjust the mounting linkage to a convenient angle that permits ease in reading the dial (but does not interfere with the task being performed). Bring the sensor button into contact with the shaft, loosen the swivel post clamp screw, raise and lower the sensor button to determine what the full travel of the indicator is. After the extent of travel has been determined, set the pointer at mid travel, secure the swivel post clamp screw, and then zero the dial with the adjustable bezel. Rotate the shaft slowly and observe the pointer for deviation. The combined deflection (plus and minus sides of the scale) is the total indicator reading (TIR).

CARE OF PRECISION INSTRUMENTS

Special treatment is required for precision instruments if they are to serve their intended purpose. The following precautions will help ensure their accuracy.

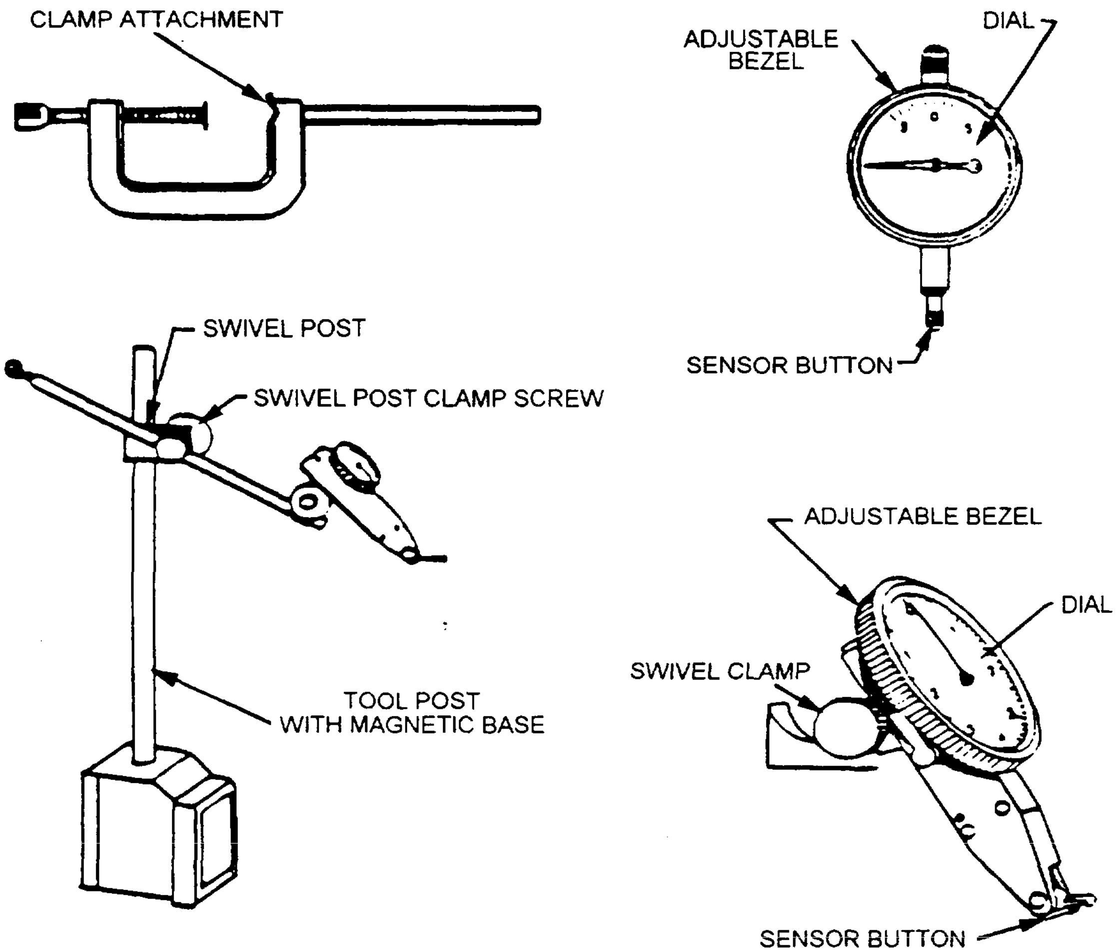


Figure 2-49.—Dial indicator and attachments.

—Keep clean and lightly oiled. (Do not oil dial indicators.)

—Always wipe an instrument clean of fingerprints before returning it to the box.

—Always verify an instrument's accuracy before using it by checking its calibration sticker.

—Have a precision instrument calibrated according to PMS, when one has been dropped or when you are in doubt about the accuracy of one.

—Always allow the temperature of a precision instrument to equalize with ambient temperature to ensure accuracy of measurements.

—Return to the box a precision instrument not in use.

—Never store a precision instrument with other tools such as wrenches, hammers, and so on.

—Never carry a precision instrument in your pocket unless it has an appropriate pocket carrying case.

—Never close a precision instrument such as an outside micrometer, vernier caliper, or dial indicator tight for storage. Temperature changes can cause frames, spindles, and so on, to become distorted.

—Never open or close a micrometer by twirling the frame.

—Never attempt to remove mill shavings or dirt from a precision instrument with an air hose. This procedure only embeds small particles into the working parts.

—Never attempt to calibrate a precision instrument yourself. Always send it to an authorized calibrating facility.

—Never attempt to clean measuring surfaces with an abrasive.

—Never force a precision instrument to attain a measurement.

—Never attempt to take readings on operating machinery.

We have to understand that even with the best tools, it is the person behind the tool who makes things work.

ABFs can take measurements accurately and new parts to be installed can be on hand. If the one who finally assembles the pump does not know how to torque a casing or pipe flange, he or she can destroy all the hard work and money that have been put into the job. For maintenance and repair on all equipment, **use the appropriate technical manuals.**

CORROSION CONTROL

LEARNING OBJECTIVES: Describe the types of corrosion the ABF will confront. Identify their signs and explain the corrective action.

The most effective repair protection is prevention. A thorough maintenance program continuously carried out prevents most equipment failure. With higher strength and closer tolerances being demanded of metals, equipment would rapidly become inoperable without regular anticorrosion maintenance.

Corrosion endangers the equipment by reducing the strength and changing the mechanical characteristics of the metals used in its construction. Materials are designed to carry certain loads and withstand given stresses as well as to provide an extra margin of strength for safety. Corrosion can weaken the structure, thereby reducing or eliminating this safety factor.

Corrosion may take place over the entire surface of a metal from chemical reaction with the surrounding environment. It may be electrochemical in nature between two metallic materials or two points on the surface of the same alloy, differing in chemical activity. The presence of moisture is essential in both types of attacks. The most familiar example of corrosion is rust found on iron or steel.

All metals are affected to some extent by the atmosphere. Water and water vapor containing salt combine with oxygen in the atmosphere and produce the main source of corrosion. There are many forms of corrosion; the form of corrosion depends upon the metal involved, atmospheric conditions, and the corrosion-producing agents present. For this discussion, we may consider corrosion as three general types-surface, galvanic, and intergranular corrosion.

SURFACE CORROSION

The effect of the atmosphere produces a corrosion that appears on the surface of a metal as a general roughening, etching, or pitting. Iron rust is the most common example of surface corrosion.

Although aluminum, magnesium, and other nonferrous metals do not rust, these metals are subject to surface corrosion. Surface corrosion on unpainted aluminum alloy is evident as white or gray powdery deposits on the metal surface. The condition is first indicated by the powdery residue deposited on the area of contact; later pitting and searing appear on the aluminum surface, and finally complete deterioration of the aluminum. Corrosion on painted aluminum-alloy surfaces cannot be recognized by either the roughened surface or by the powdery deposit. Instead, the paint or plating appears to lift off the surface, indicated by a blistered appearance and/or discoloration that results from the pressure of the underlying accumulation of the corrosion products.

Surface corrosion on magnesium alloys can be recognized by powdered or roughened surfaces. Magnesium corrosion products are white and quite large compared to the size of the base metal being corroded. The deposits have a tendency to raise slightly, and the corrosion spreads rapidly. When white, puffy areas are discovered on magnesium, prompt attention is required to prevent the corrosion from penetrating entirely through the structure. This can occur in a very short time.

It has been generally established that surface corrosion is caused by moisture in the air. Since this type of corrosion is visible, it can be detected in its early stages by close visual inspection. Surface corrosion can be prevented or retarded by protecting the metal surface with a plating or paint and by keeping the plating or paint in good condition.

GALVANIC CORROSION

Galvanic (or electrolytic) corrosion occurs when two different metals are connected and exposed to an electrolyte such as water, especially salt water. When aluminum pieces are attached with steel bolts or screws, galvanic corrosion may occur between the aluminum and steel in the presence of moisture. An electrical potential is setup, current flows between the two metals, and an effect similar to that which occurs in batteries is produced. Galvanic corrosion can usually be recognized by the presence of a buildup of corrosion products at the joint between two metals. Preventive measures include painting and plating.

INTERGRANULAR CORROSION

The third type of corrosion, intergranular, is not visible on the surface and is very dangerous. It spreads through the interior of the metal along the grain boundaries, reducing the strength and destroying the ability of the metal to be formed or shaped. Among the metals affected by this type of corrosion are stainless steel, certain magnesium alloys, and the copper-bearing aluminum alloys.

Intergranular corrosion occurs in certain grades of stainless steel when the steel is heated as in welding. Brittleness results, and later the metal cracks near the weld. For this reason, a post-weld heat treatment is needed before you reinstall stainless steel parts that have been welded.

As an ABF, you are going to be concerned mainly with the first two types of corrosion, surface and galvanic. With this in mind, remember that rust on steel and the white powder on aluminum or magnesium are produced by corrosion. These products, along with dirt and salt, pick up moisture from the air and hold it in contact with the metal, which speeds up the corrosive action.

CORROSION REPAIR

There are many factors that affect the type, speed, cause, and seriousness of metal corrosion. Some of these corrosion factors can be controlled; others cannot. Preventive maintenance factors, such as inspection, cleaning, painting, and preservation, are within the control of the operating activity.

When you first find corrosion on equipment or a structure, the first step you take should be the safe and complete removal of the corrosion deposits or replacement of the affected part. Whether you remove the corrosion or replace the part depends upon the degree of corrosion, the extent of damage, the capability to repair or replace, and the availability of replacement parts. Any parts that have been damaged by corrosion should be replaced if continued use is likely to result in structural failure. Areas to be treated to eliminate corrosion deposits must be clean, unpainted, and free from oil and grease. Chips, burrs, flakes of residue, and surface oxides must be removed. However, be careful to avoid removing too much of the uncorroded surface metal. Corrosion deposit removal must be complete. Failure to clean away surface debris permits the corrosion process to continue even after the affected areas have been refinished.

When corrosion is present, any protective paint films must first be removed to ensure that the entire corroded area is visible. After you remove corrosion, the extent of damage must be assessed. It is at this point that you determine whether to repair or replace the affected part or to perform a corrosion correction treatment. The correction treatment involves neutralizing any residual corrosion materials that may remain in pits and crevices, and restoring permanent protective coatings and paint finishes.

CORROSION PREVENTION

Corrosion can be controlled by maintaining a dry environment using suitable moisture barriers or drying agents. CLEAN, DRY METALS DO NOT CORRODE. Therefore, when moisture and dirt are permanently removed from metal surfaces, the tendency of such surfaces to corrode is usually eliminated. Thus, it follows that the major problem in the prevention of corrosion consists of adequately removing moisture and dirt from the surface of the metal to be protected and covering these surfaces to prevent recontamination.

Consistent preventive maintenance is the most practical method of controlling metal corrosion. Maintenance such as cleaning, painting, and preservation shows great savings in labor and materials by eliminating costly repairs and replacements required when corrosion has been permitted to go unarrested.

To effectively remove oil, grease, dirt, and other undesirable foreign deposits, you should use certain cleaning agents, such as soaps, solvents, emulsion compounds, and chemicals. When you work with these agents, you should follow the correct method and sequence of procedure in applying them. You also must follow the accepted safety regulations and health precautions in the use and handling of the various cleaning agents. The important factors bearing on the choice of cleaning materials are the type and surfaces to be cleaned, such as painted or unpainted surfaces, and whether they are exterior or interior parts.

Uses of Paint

To prevent corrosion of metal (or deterioration of wood surfaces), you should repaint damaged or worn surfaces as soon as practical. Repaint no more often than is necessary for preservation. In the Navy, paint is used primarily for the preservation of surfaces. It seals the pores of wood and steel, arrests decay, and helps prevent the formation of rust. Paint also serves a variety of other purposes. It is valuable as an aid to cleanliness and sanitation, both because of its antiseptic properties and because it provides a smooth, washable surface. Paint also is used to reflector to absorb light or to redistribute light. For example, light-colored paint is used in the interior of the ship to distribute natural and artificial light to the best advantage. These same properties of reflection and absorption, incidentally, make camouflage painting possible. For these and other reasons, the Navy uses a great deal of paint.

Recommended Painting Procedures

As you know, there are many kinds of paint. For example, you cannot use the same type of paint on the deck, topside, and bulkheads in the captain's cabin. There is a different paint made for almost every purpose. Detailed instructions on the proper paint to use for each job may be found in the applicable NAVSEA instructions.

The most important single factor in securing good paint performance is proper surface preparation. Dirt, oil, grease, and rust or mill scale must be removed completely, and the surface must be thoroughly dry.

Equipment used to prepare surfaces includes hand tools, power tools, sandblasters and shot blasters, soap (or detergents) and water, and various paint and varnish removers.

Each year the Navy spends thousands of dollars developing and testing finishes for specific surfaces. Consequently, you have the best material available. If you prepare the surface properly, use the recommended finish, and apply the finish correctly, you can have a first-rate job that lasts a long time. Do not use any material not provided by or methods not recommended by the Navy.

Lubrication and Inspection

Preservation of equipment and spare parts is a continuous job aboard a ship. The moist salt air causes rust to form in a very short time. The operation and maintenance manual for each particular item will indicate the type of preservation to be used and which parts should be painted.

Moving parts must be kept free of corrosion by application of the proper lubricant. Parts that cannot be painted and that are not used very often should be coated with a preservative compound that is readily removable with solvents or can be wiped off. Dirt and rust should be removed carefully before applying preservatives or lubricants.

Such items as webbing and rubber goods require no preservative; however, they should be stowed in a clean, dry place when not in use. These items are subject to deterioration because of age and should be inspected frequently. When the over-age date (stamped on the webbing) is reached, the material should be discarded and replaced.

BLUEPRINTS AND DRAWINGS

LEARNING OBJECTIVE: Describe the information contained in blueprints, charts, and drawings.

All ABFs must be able to read blueprints and drawings. As you advance in rating, you are expected to be able to make sketches and drawings.

A sketch is made freehand and shows rough outlines and only those details that are necessary to visualize a system or an object. A drawing is similar to a sketch, but it is made with mechanical drawing instruments and is drawn to scale.

A blueprint is a duplicate of a drawing or sketch. Usually, only accurate drawings are blueprinted. These blueprints are furnished by the manufacturers of the machinery and equipment installed and used aboard ship, and also by the personnel concerned with the building and maintenance of the ship.

Mechanical drawing is a special language and is defined as follows: "A language which uses lines, symbols, dimensions, and notations to accurately describe the form, size, kind of material, finish, and construction of an object."

Blueprints are the link between the engineers who design equipment and the people who build, maintain. and repair it. In a comparatively little space, they give a great deal of information in a universal language easily understood.

Of the many types of blueprints you may use aboard ship, the simplest one is the plan view. This blueprint shows the position, location, and use of the various parts of the ship. You may use plan views to find your duty and battle stations, the sick bay, the barbershop, and other parts of the ship.

In addition to plan views, you will find aboard ship other blueprints called assembly prints. These prints show various kinds of machinery and mechanical equipment. Assembly prints show the various parts of the mechanism, how the parts fit together, and their relation to each other.

Individual mechanisms, such as motors and pumps, are shown on unit or subassembly prints. These show location. shape. size, and relationships of the parts of the subassembly or unit. Assembly and subassembly prints are used to learn operation and maintenance of machines, systems, and equipment.

Additional detailed information about mechanical drawing and the reading of prints and drawings is contained in *Blueprint Reading and Sketching,* NAVEDTRA 10077-F1.

PLANNED MAINTENANCE SYSTEM

LEARNING OBJECTIVES: Describe the 3-M systems' purpose. Explain how the ABF will use the 3-M systems.

Heads up thinking and asking questions can make your work as an ABF run smoothly. On a day-to-day basis, you come in contact with PMS. The PMS (Planned Maintenance System) weekly schedule displays the planned maintenance scheduled to be done in your work center for a specific week. The weekly PMS schedule is posted in each work center. It is used by the work center supervisor to assign and monitor the accomplishment of the required PMS tasks by work center personnel.

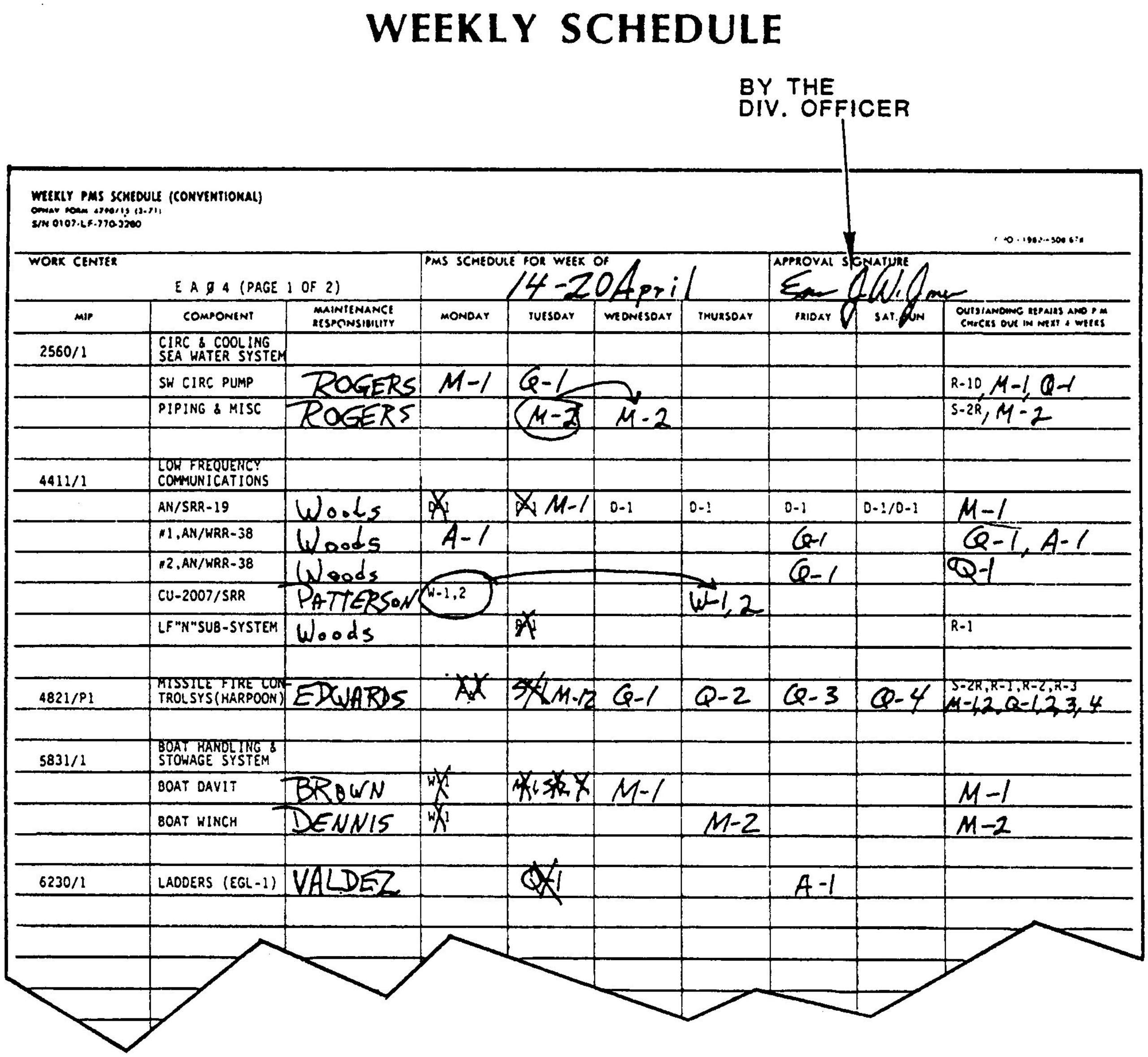
The following is a list of the contents of weekly PMS schedules (fig. 2-50).

1. Work center code.

2. Date of current week.

3. Division officer's approval signature.

4. MIP code minus the date code.



WEEKLY PMS SCHEDULE (CONVENTIONAL)
OPNAV FORM 4790/15 (3-71)
S/N 0107-LF-770-3200

WORK CENTER: E A Ø 4 (PAGE 1 OF 2) | PMS SCHEDULE FOR WEEK OF: 14-20 April | APPROVAL SIGNATURE: [illegible]

MIP	COMPONENT	MAINTENANCE RESPONSIBILITY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SAT. SUN	OUTSTANDING REPAIRS AND P M CHECKS DUE IN NEXT 4 WEEKS
2560/1	CIRC & COOLING SEA WATER SYSTEM								
	SW CIRC PUMP	ROGERS	M-1	Q-1					R-1D, M-1, Q-1
	PIPING & MISC	ROGERS		M-2	M-2				S-2R, M-2
4411/1	LOW FREQUENCY COMMUNICATIONS								
	AN/SRR-19	Woods	~~D-1~~	~~D-1~~ M-1	D-1	D-1	D-1	D-1/D-1	M-1
	#1,AN/WRR-38	Woods	A-1				Q-1		Q-1, A-1
	#2,AN/WRR-38	Woods					Q-1		Q-1
	CU-2007/SRR	PATTERSON	W-1,2			W-1,2			
	LF"N"SUB-SYSTEM	Woods		~~R-1~~					R-1
4821/P1	MISSILE FIRE CONTROLSYS(HARPOON)	EDWARDS	~~A-1~~	~~S-1~~ M-1,2	Q-1	Q-2	Q-3	Q-4	S-2R,R-1,R-2,R-3 M-1,2, Q-1,2,3,4
5831/1	BOAT HANDLING & STOWAGE SYSTEM								
	BOAT DAVIT	BROWN	~~W-1~~	[illegible]	M-1				M-1
	BOAT WINCH	DENNIS	~~W-1~~			M-2			M-2
6230/1	LADDERS (EGL-1)	VALDEZ		~~Q-1~~			A-1		

Figure 2-50.—Weekly PMS schedule.

5. A list of applicable components.

6. Maintenance responsibilities assigned, by name, to each line item of equipment.

7. The periodicity codes of maintenance requirements to be performed, listed by columns for each day.

8. Outstanding major repairs, applicable PMS requirements, and all situation requirements.

As with any system, things change; as they do, there must be a way to communicate. In PMS the way is called the PMS FBR (Feedback Report, OPNAV 4790/7B Form). The PMS FBR is used by fleet personnel to notify the NAVSEACEN and/or the TYCOM, as applicable, of matters related to PMS. The FBR is a five-part form composed of an original and four copies. Instructions for preparation and submission of the form are printed on the back of the last copy. These forms are obtained through the Navy Supply System. They are to be prepared, submitted, and processed in two major categories.

The two major categories of FBRs are category A and category B. These are defined as follows:

Category A of FBR is nontechnical in nature and is intended to meet PMS needs that do not require technical review. Consequently, to reduce response time, the ship's 3-M coordinator submits directly to the NAVSEACEN these FBRs, which pertain to the need for replacement of missing MIPs and MRCs.

Category B FBRs are technical in nature. They are submitted by the ship's 3-M coordinator to the applicable TYCOM and pertain to the following:

1. Technical discrepancies inhibiting PMS performance. These discrepancies can exist in "documentation, equipment design, maintainability, reliability, or safety procedures as well as operational deficiencies in PMS support (parts, tools, and test equipment). Discrepancies in technical manuals are reported by way of the TMDER (Technical Manual Deficiency/Evaluation Report), NAVSEA 4160/1.

2. Notification of shift of maintenance responsibility from one work center to another.

3. TYCOM assistance in the clarification of 3-M instructions.

CAUTION

When the reason for submission of a PMS FBR involves safety of personnel or potential or actual damage to equipment and relates to the technical requirements of PMS, the FBR is considered URGENT. Urgent FBRs are forwarded by a naval message, containing a PMS feedback serial number, to the NAVSEACEN with information copies to the cognizant SYCOM/NAVMEDCOM/NAVSAFECEN. The message must describe the unsafe procedures or conditions and must identify the MIP/MRC involved. A follow-up PMS FBR may be submitted to amplify information contained in the message. It must contain reference to the message and the FBR serial number indicated in the message subject.

For complete information on PMS, consult the *SHIPS' 3-M MANUAL*, OPNAVINST 4790.4.

QUALITY ASSURANCE (QA) PROGRAM

LEARNING OBJECTIVES: Describe the purpose of the Quality Assurance Program. Explain the areas in which it will apply to maintenance performed by the ABF.

A Quality Assurance Program is essential to ensure consistent, quality repairs and maintenance of shipboard equipment. The QA Program is intended to improve force readiness through the implementation of a formalized plan that sets forth minimum requirements to be accomplished for nonnuclear maintenance and repair actions performed by forces afloat. The *Quality Assurance Manual (Forces Afloat)*, COMNAVAIRPAC/LANTINST 9090.1, provides the plan and contains the necessary guidance to establish an effective and viable QA Program.

The QA Program is important to the ABF because JP-5 piping, valves, tanks, pumps, filters, and most other equipment related to the JP-5 system are included in its coverage. Do not confuse the QA Program, which is designed to ensure quality maintenance on equipment, with Quality Surveillance, which is used to ensure high quality fuel is delivered to aircraft.

The QA Program is intended to achieve quality work through internal audits and in-process inspections. In-process is defined as that period of time during which the fabrication, maintenance, and/or repair task is being accomplished. For forces afloat, the in-process inspection control document is the controlled work package (CWP).

A CWP is developed to ensure a quality product will result from in-process fabrication, maintenance, and repair tasks. There are two primary objectives a CWP must accomplish; first, it must provide the quality control techniques and all the technical information needed to accomplish the work properly. Secondly, it must provide objective quality evidence (OQE), so when the work is completed, a documented record exists to show the work was done correctly and to specified standards.

The typical CWP consists of references, various enclosures that include applicable QA forms, material requirements, prerequisites, safety precautions, general notes, and a step-by-step work sequence, including tests and inspections, with signature requirements. Each CWP will cover the entire scope of the work process and will be able to stand close examination based solely on its contents.

SAFETY PRECAUTIONS

LEARNING OBJECTIVE: State the ABF's responsibility in observing safety precautions.

Many personnel confront dangers in their workday lives, and a number of safety precautions apply to all personnel at one time or another. A shipboard environment "introduces factors affecting safety that are not found ashore. Underway refueling, multiship exercises, storms, and other situations require personnel at sea to be constantly vigilant. An accident at sea can involve all hands in a matter of seconds. Everyone must be continually alert to hazardous conditions. *Navy Safety Precautions for Forces Afloat,* OPNAVINST 5100.19, provides a general reference for mandatory and advisory safety precautions.

You need not learn each safety precaution by heart, but you should know what each means and why it should be observed. Although most of the precautions given here are from a shipboard viewpoint, many of them apply equally well ashore. The hazards presented by improperly grounded electrical tools, for example, are the same everywhere. Remember: Accidents seldom just happen, they are caused. Another point to remember is never let familiarity breed contempt. Hundreds of people have been injured by accidents, and many have died because of their injuries. Most of those accidents could have been prevented had the personnel involved heeded the proper safety precautions.

It is the responsibility of supervisory personnel to ensure that subordinates are instructed in and carry out the applicable safety precautions for their work and work areas. You are responsible for knowing, understanding, and observing all safety precautions that apply to your work and work area. In addition, YOU are responsible for the following:

—You shall report for work rested and emotionally prepared for the tasks at hand.

—You shall use normal reasoning in all your functions, equal with the work at hand.

—You shall report any unsafe condition, or any equipment or material that you consider unsafe, and any unusual or developing hazards.

—You shall warn others whom you believe to be endangered by known hazards or by failure to observe safety precautions, and of any unusual or developing hazards.

—You shall report to your supervisor any accident, injury, or evidence of impaired health occurring in the course of work.

—You shall wear or use the protective clothing and/or equipment of the type required, approved, and supplied for the safe performance of your duties.

—You shall report for work suitably clothed for your assigned tasks.

Suitable clothing is that normally worn by members of the trade or profession. Certain hair styles are hazardous around machinery and open flame and may interfere with vision or use of breathing devices. Hair shall be suitably restrained in caps or nets. Safety shoes or foot protection devices, including nonsparking and nonslip shoes, shall be worn when hazards so indicate. Jewelry, loose scarves, and ties shall not be worn when they might subject the wearer to additional hazards. Anyone requiring eye correction, hearing aids, or prosthetic devices to assure prompt perception and avoidance of hazards must use such devices while at work.

SUMMARY

In this chapter, you have learned about basic hand and power tools, precision tools, the Planned Maintenance System, the Quality Assurance Program, and general safety.

All you have learned in this chapter is to help you maintain and repair your equipment safely and obtain quality results. However, there is no way to teach integrity to an individual. You will often be required to perform maintenance or repairs alone. Do quality work. Your life, and the lives of others may depend on it!